P '16 '08

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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 31. 505 PEARL STREET, NEW YORK. No. 16.

AP 16 '08

Index to Advertisers and Classified Index Following Reading Matter.

Change of Name

Evolution is change—development—progress. We have just evolved from THE CLEVELAND CAP SCREW CO., to THE ELECTRIC WELDING PRODUCTS CO. by changing our name to more fittingly cover the development of our business from screws and bolts alone to various other electrically welded products too, which we have been making for some time. By the addition of new products and equipment from time to time we have progressed remarkably, both with new and our old customers, resulting in a better and largely increased trade.

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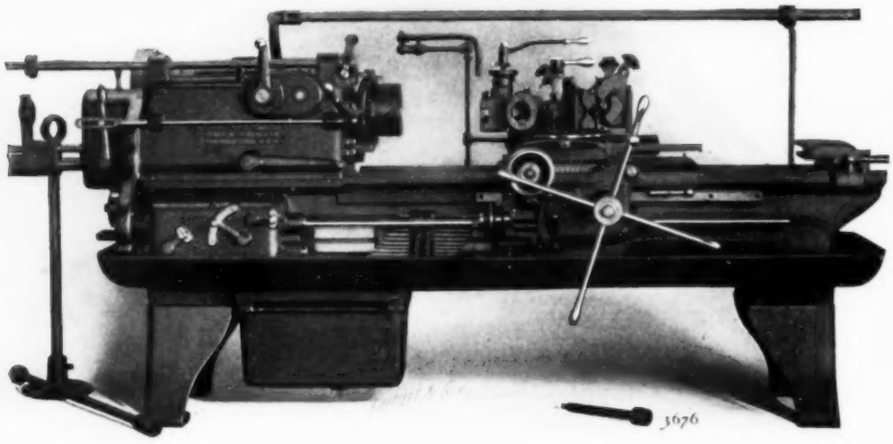

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30 per cent. *heavier* than any turret lathe of its size.

Horizontal locking bolt, directly under cutting tool, obviates all tendency to force turret from its seat.

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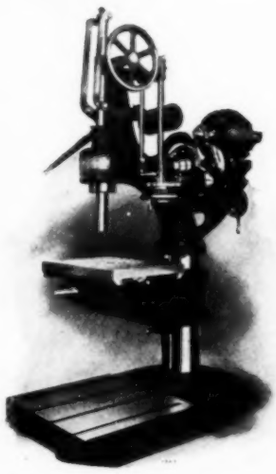

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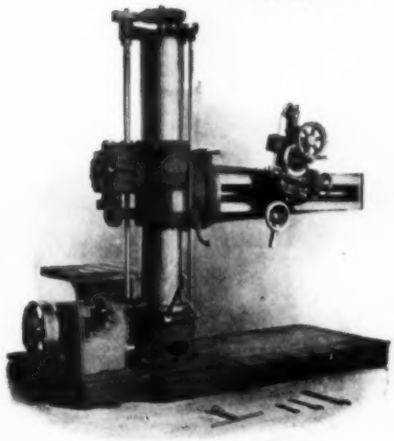

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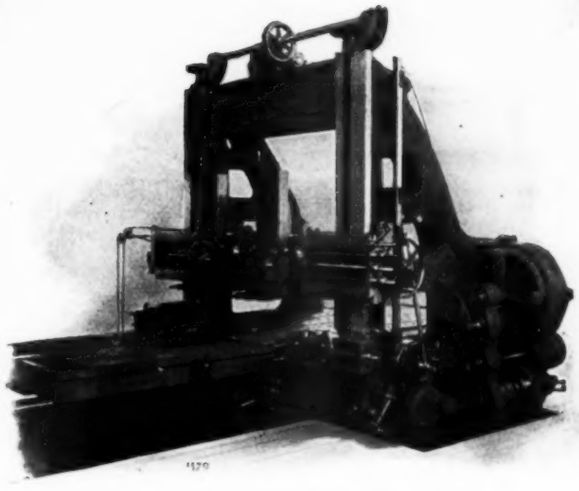

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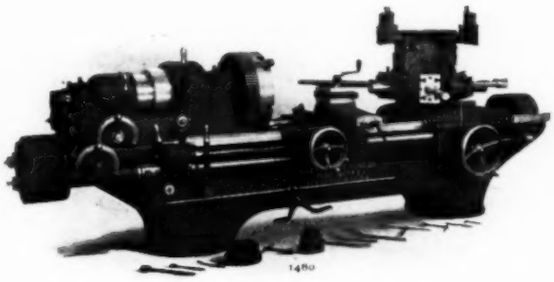
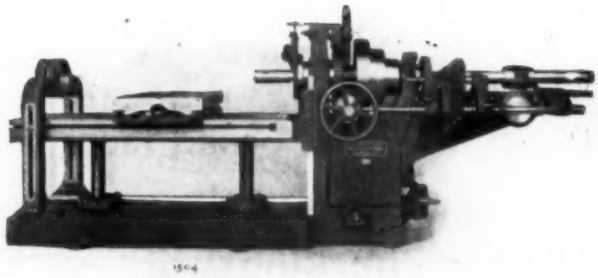


Pond Rigid Turret Lathe. Two Sizes.



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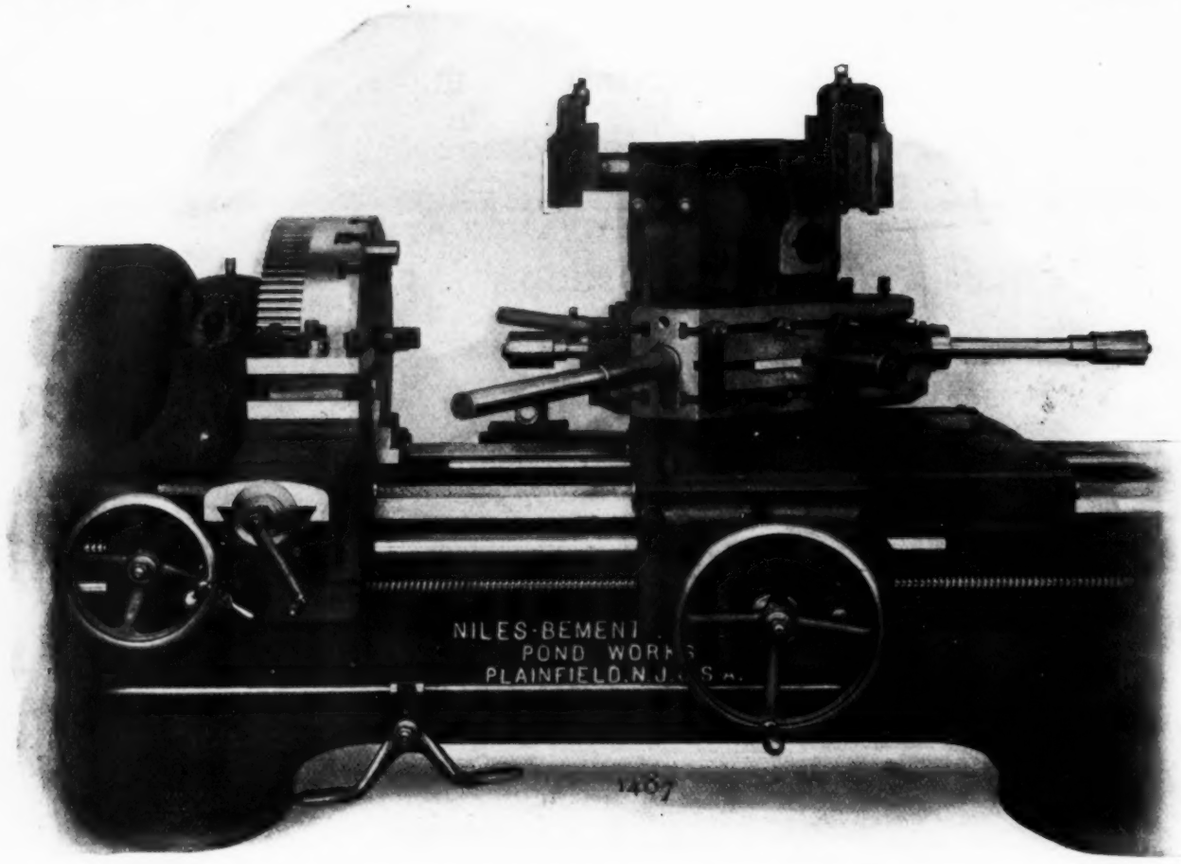
POND RIGID TURRET LATHE



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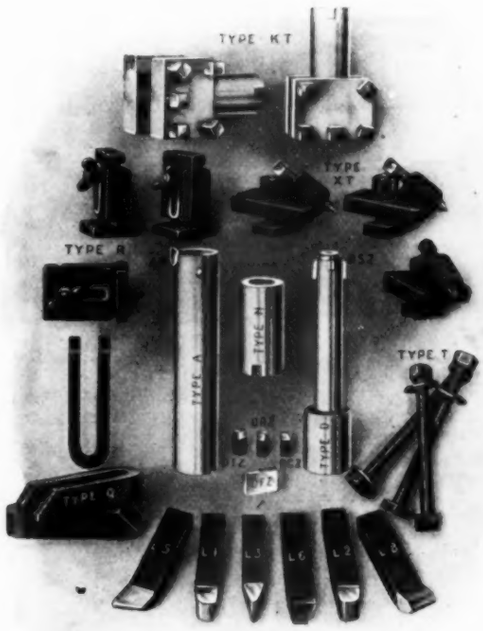

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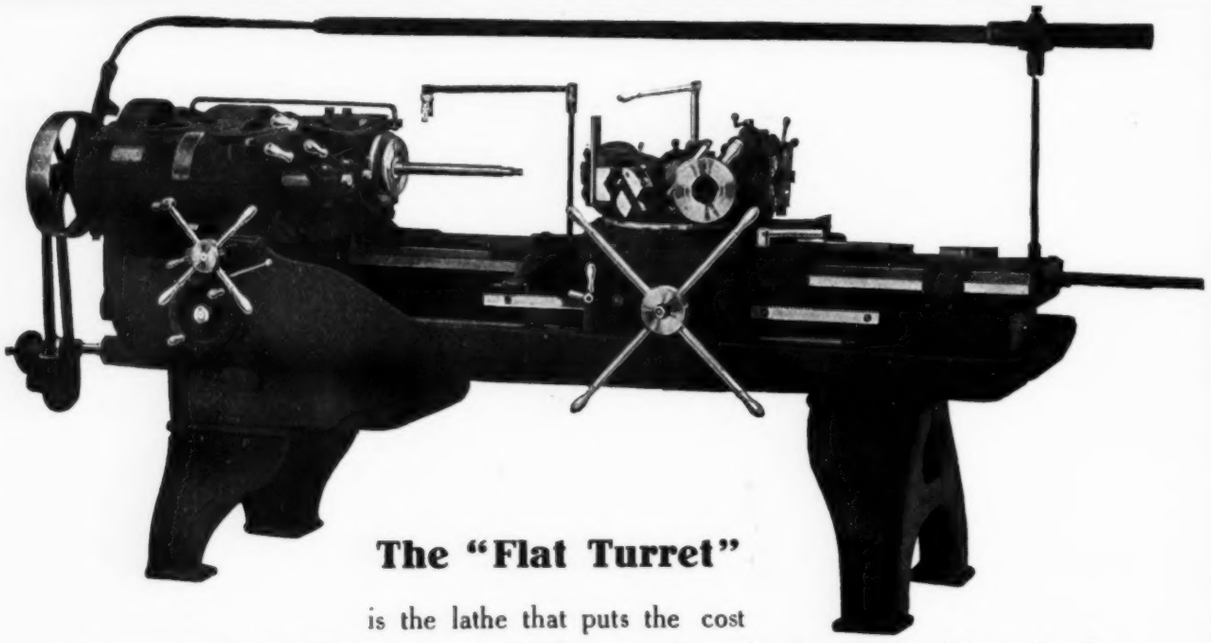

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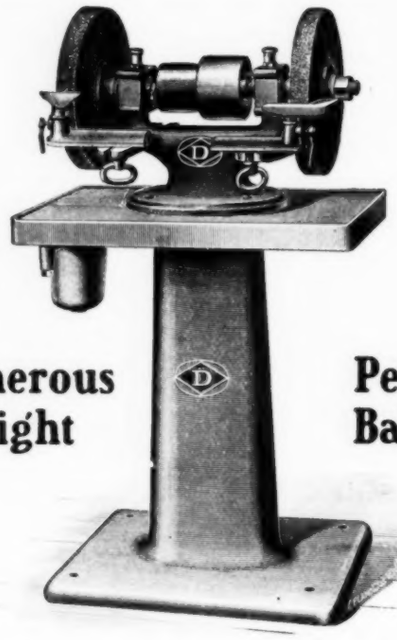

Generous Weight **Perfect Balance**

Tool rests easily adjustable close to the face of the wheels. Surface attachments may be used. A water bucket attached to the table may be swung out of the way when not in use. *Full details on request.*

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A Time Recorder for Machine Tools

Lines Automatically Drawn on a Revolving Chart, Graduated in Hours and Minutes, Record Working and Idle Time for Any Machine

BY N. D. CHARD*

The accompanying illustrations show an instrument for recording the actual cutting and idle time of machine tools and other machines. The instrument is the invention of Geo. F. Card, of the Fort Wayne Electric Works, Fort Wayne, Indiana, and has been at work for some time in the works of the Lodge & Shipley Machine Tool Company, where it has been the means of acquiring much valuable information.

Fig. 1 illustrates the instrument as set up in our office. The instrument here shown being the first one made has a somewhat extemporized appearance and for this reason Fig. 2 is added showing it as now made in more finished form.

While the instrument is intended primarily to determine the actual amount of useful or cutting time during the day, it also shows the exact length of time put in on any given piece of work by registering the time elapsed between the beginning and ending of each cutting and it also shows the time consumed in chucking and setting up the tools for various jobs. Delay in starting in the morning and premature stopping at night are also shown.

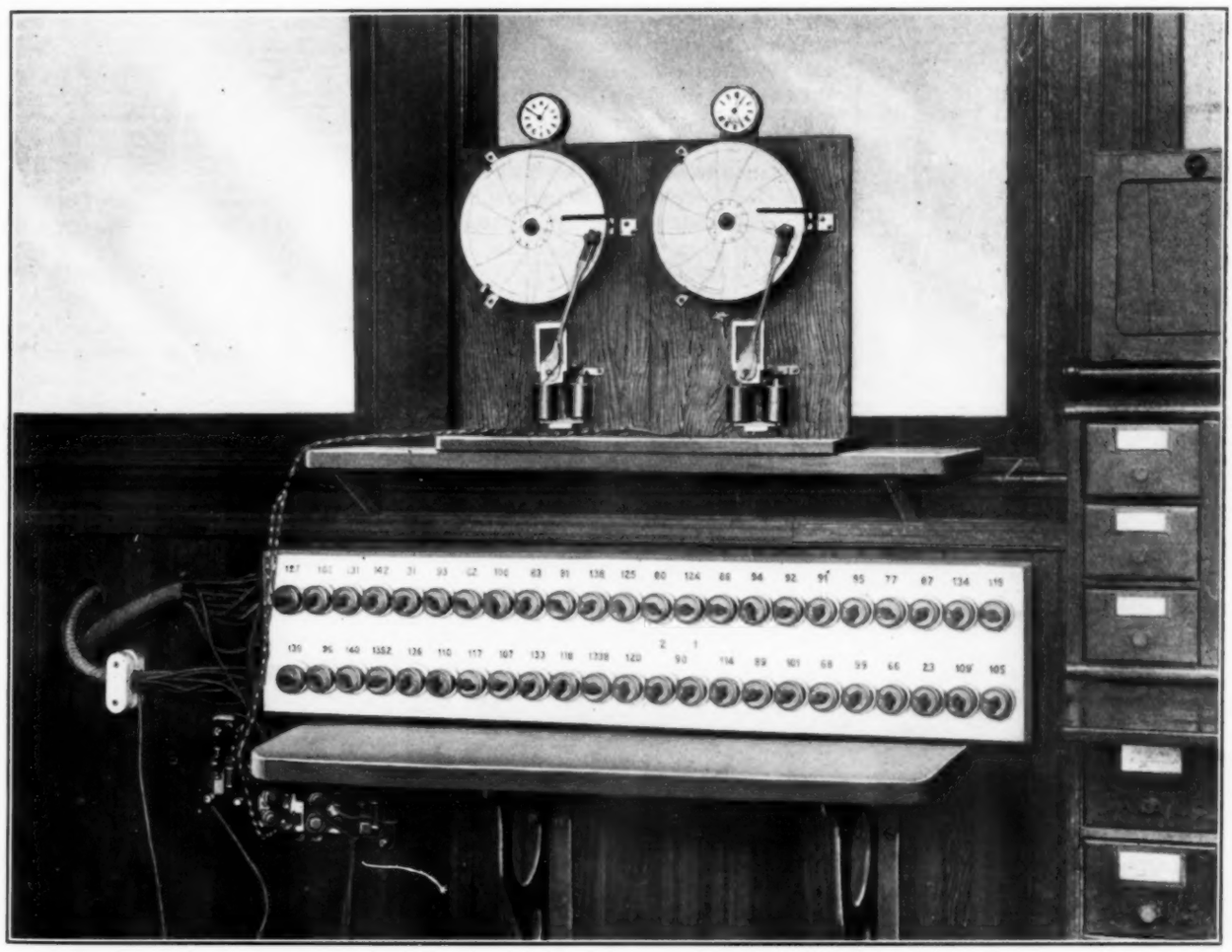


FIG. 1. THE CARD MACHINE RECORDER AS SET UP AT THE LODGE & SHIPLEY WORKS

Fig. 1 shows a wall desk used in connection with the apparatus and above it a series of switches numbered to agree with the various machines in the shop, by the turning of which any machine may be placed under observation. The two recorders shown permit simultaneous observations to be made on two machines. Each switch is connected with the belt shifter on the countershaft of the machine it represents in such manner that when the bell is thrown on the tight pulley an electrical contact is made and an electrical current is transmitted to the magnet of the recorder causing the pen to press against the paper dial and draw a red line while the machine is in operation.

When the driving belt is thrown on the loose pulley by the operation of the shifter the electrical contact is broken and the magnet released, a small spring then causing the pen to draw away from the dial, resulting in a break in the line which shows the length of time during which the machine was at rest. At the end of the day when the record is complete, comparison of the lines shows the variation in actual running time on each piece while a comparison of the lines with the gaps between shows the relation between the cutting and the idle time.

The paper dial is attached to the arbor

*Superintendent the Lodge & Shipley Machine Tool Company.

of the minute hand of a clock immediately behind the chart and thus makes a complete revolution each hour. The minute-hand arbor extends through the chart

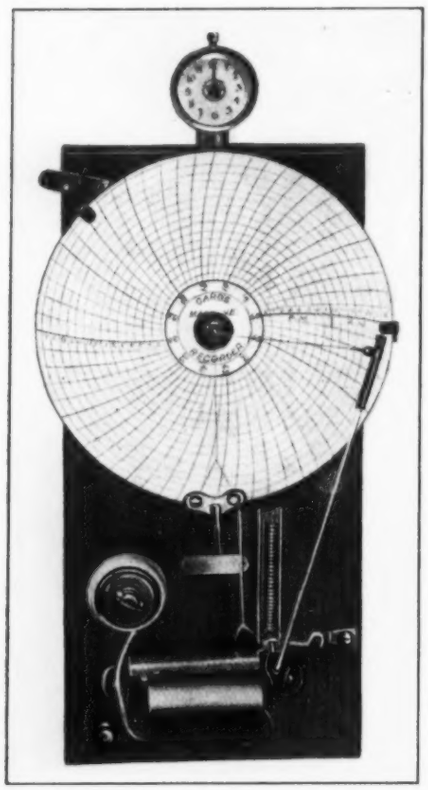


FIG. 2. THE CARD RECORDER AS NOW MADE

where it is turned to such size that a weighted silk cord, plainly shown in the illustration with its right-hand end attached to the swinging pen arm will draw the pen inward each hour by a distance equal to the radial width of the chart graduations. It is thus clear that if the pen were in constant contact with the paper it would, beginning at the outer diameter, trace a spiral line between the spiral divisions of the chart which latter represent the hours of the day, while the curved radial lines represent the minutes of each hour, the five-minute lines being heavier for distinction. The beginning of each hour is shown by a triple line. The radial location of a record thus locates the time of day when it was made and its length shows the elapsed time during which the pen was in contact with the paper.

In addition to the detailed record of the chart the instrument is made to sum up automatically the total amount of cutting time for each day's work, which is done by the small clock above the chart. This clock is fitted with a stop movement connected by a small wire with the magnet which operates the pen, the connection being such that when the machine under observation is in motion the clock is also in motion, while when the machine is idle the clock stands still. When an observation upon a machine is begun the clock is set at 12 o'clock and thus as the work goes on the cutting time is added up, the reading of the clock when the work is done giving the total cutting time.

Fig. 3 is a reproduction of a record taken from an engine lathe at our works. An examination of the record shows that of a full day's work of 10 hours the running time was 4 hours, or 40 per cent. of the total, while the idle time was 6 hours, or 60 per cent. of the total. The first impression gained from this record is that something was wrong, but on closer investigation we find that from 6:45 to 12:35 a.m. the machine was turning, facing and making a lot of studs and that from 12:35 to 5:15 p.m. it was turning, facing and making screws. Comparing the two records we find that for the first job

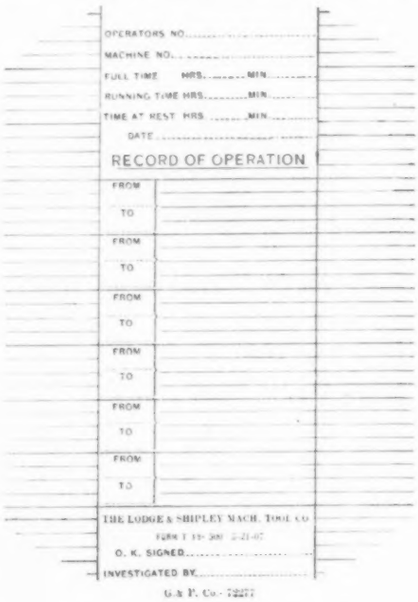


FIG. 5. REAR SIDE OF CHART

the time exceeds the running time, whereas for the second job the running time exceeds the idle time, and therefore in sizing up the record the conclusion is that the operator was reasonably attentive and that the fault was not his, but rather the foreman's, either in not properly laying out the work or in not giving the proper instructions for setting and handling the work. Fig. 4 shows a record from a turret lathe the percentages being 70 for the running and 30 for the idle time. This

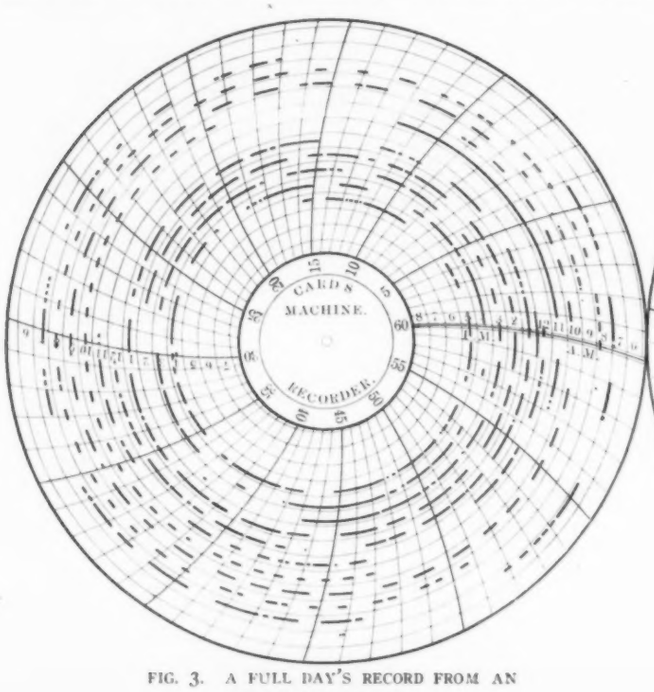


FIG. 3. A FULL DAY'S RECORD FROM AN ENGINE LATHE

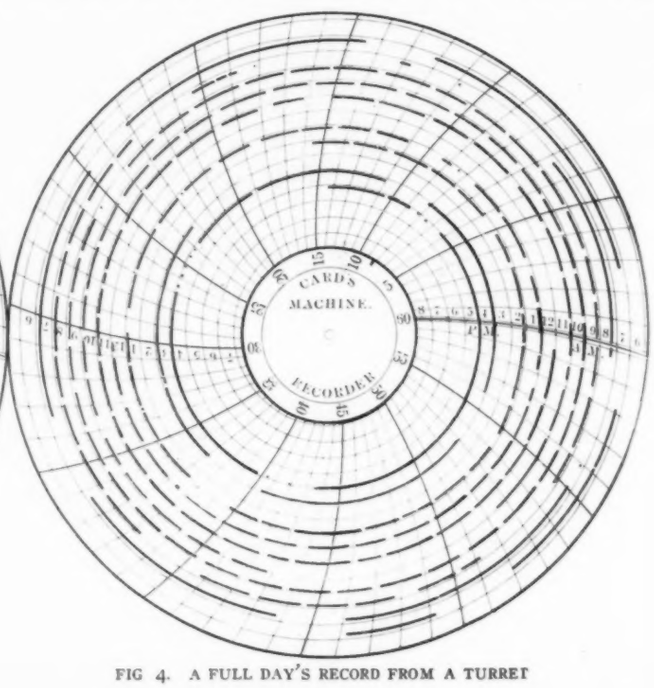


FIG 4. A FULL DAY'S RECORD FROM A TURRET LATHE

DIAMETER OF ORIGINAL CHARTS, 9 INCHES

is a very good record, especially when it is considered that the long break from 2:15 to 3:30 p.m. was due to the machine being shut down on account of setting up for a second job. The uniformity in the length of the registration in this case is also an indication that the workman was not negligent.

This conclusion is an illustration of the kind of information which is obtained from the charts. When the percentage of useful time is found to be unusually low an investigation is of course made and the result in many cases has been to show unsuspected defects in the equipment, leading to lost time. Considerable gains which stand to the credit of the instrument have been made in this way.

The back side of the chart is ruled as shown in Fig. 5. After the proper entries are made the charts are filed away in proper order for future reference and comparison.

A New Spherical Grinder

Those who are familiar with the Dock gas engine will recall that it has a connecting rod with a ball cup in place of a piston or wrist pin, as can be seen on the three rods on the bed of the grinder at the left. These rods are held in the chuck, steadied in the rest at the end and then the two wheels get to work on the ball cup at the end.

The business end of the machine carries the two grinding heads on one base, at right angles to each other, and this base swings around a central pin in line with the center of the connecting rod. Then as the grinding heads are swung around, the wheels move in circles whose size depends on the distance from the grinding edge to the center.

The rod shown through the center of the bearing is used to locate the center of the ball in setting the connecting rods and after this is done, the grinding is easy as one wheel grinds the outside and the other the inside. As both are mounted on the one base they can be moved by either handle as is most convenient.

The heads swivel and have a cross movement on the main slide in addition to the main slide movement to and from the center so that any adjustment desired can be readily and accurately obtained. The bed allows for a large variation in the length of rods and the machine seems to be very complete in every detail. It was built by the Rivett Lathe Manufacturing Company, Fanueil, Mass.

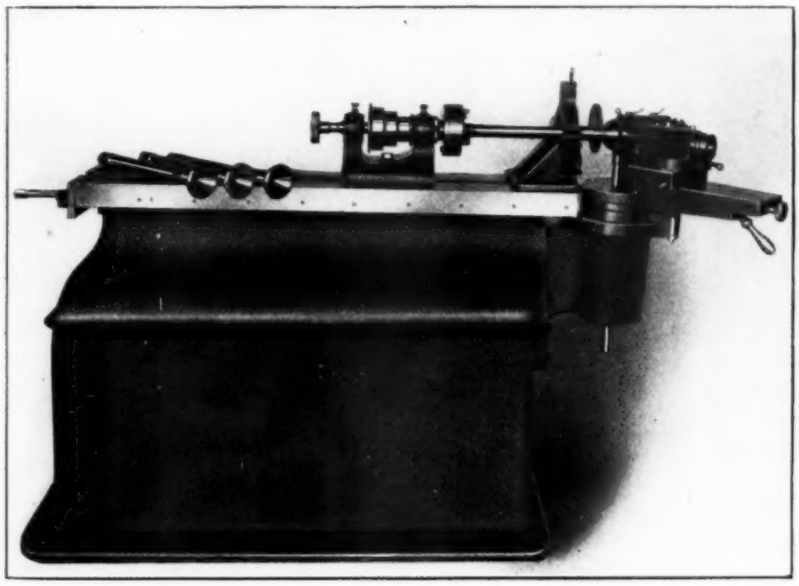


FIG. 1. DOUBLE GRINDER FOR BALL-JOINT CONNECTING RODS

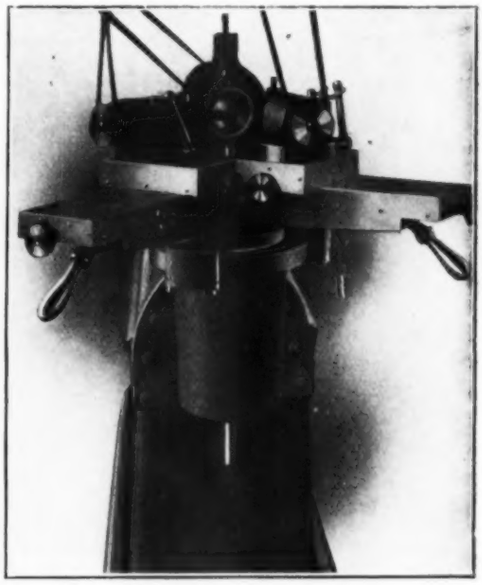


FIG. 2. END VIEW OF GRINDER

After I Have Served my Apprenticeship What Shall I Do?

By J. G. Dornbirer

Is there any apprentice whose mind has not suggested this question?

Any young man who has faithfully fulfilled his part of the usual agreement, has shown a moral stamina that places him several steps up the ladder of developing manhood. But the next step is the one having the greatest influence on his future career.

Say, young man, have you ever at that critical time been approached by some pessimistic old grouch with the suggestion that the shop in which you have served your honorable apprenticeship has nothing more for you to learn? That you go out and burn away several years of your life in quest of something you might easily have learned in the old shop? Have not you often seen work done in the above said shop by others that you would like to learn? Can you do good work without taking an enormous amount of time? You might go to another shop and get a job that would be just the thing at which as an apprentice you were most expert, and your new employer, not knowing this, could and would pay you more than your former boss. But would you learn anything? Some common job which any machinist ought to do might send you hiking after an express wagon to get your tool chest. Your newness as a machinist would not be looked upon with patience as the former boss did, who knew the circumstances.

Or some dissipated and broken down bum has approached you with the remark, "Now Johnny you'll soon get more wages so that you can live like a man," and thus entice you to go out with him some evening, and later every evening, to blow in the money which you should save for future use. This fellow might influence you to stay with the old boss as long as he held his job, otherwise he might lose a valuable perquisite.

Did you ever get "Dementia Americana" so bad that your only object in staying was to accumulate money enough to start a grocery store, and then, when you had accumulated about a thousand dollars (by being nothing but a brainless and an unprogressive machine) go and commit the crime? If money is the object and continues to be so throughout your apprenticeship, and you make it the uppermost object in your mind, I would suggest that you start a private mint; it is easier until you are "jugged."

Did anybody ever suggest to you that the boss needed an intelligent young assistant and eventually a successor? Did you ever have the good sober thought come to you that everybody can't be boss nor employer? Your aim should be to

become a proficient and contented factor, whose duty as a producer is so honorably fulfilled that your boss becomes uneasy when starting-up time comes and he does not see you at your usual place? Did it ever occur to you that, if you applied yourself properly, you might discover a better method of doing things and be of considerable more value to society than the country-town banker? For the honest, industrious, contented young man there are almost endless opportunities. Don't be contented with doing one thing well; there are a lot of men who can do that. The quickest way to learn to do several things well is to stay at a place, or go to a place where you have such an opportunity. Bear in mind that the job as superintendent, foreman or boss is not the easiest thing in the world.

We often come in contact with such officials who would make splendid assistants on a farm, a fact which is discovered after the trial has been made, notwithstanding their mechanical ability.

When by dint of hard work and thorough application you have stepped ahead, and get the notion that you are a permanent fixture regardless of any further efforts, it will soon dawn upon you that hitting the pipe doesn't pay. Don't use the clock in the shop to gage the length between sighs. Use it to see if you have acomplished the work in such time, that, if you were having the work done, you would be willing to pay the proprietor a fair profit above the cost of production.

I once knew a foreman who forbade looking at the clock. I knew another who advised sizing it up frequently to take notice how long it took to do *nothing*. Lastly, don't sit around on the bench at noon and tell about the wages you got at your former place, but make an honest effort to earn that fabulous sum: Others who know will respect you more, including yourself.

A Hand Broaching Machine

By A. C. Pletz

There are quite a few concerns around the country that have small internal keyseats and oil grooves to cut. The usual process for a job of this kind is on a shaper. While a shaper is a fairly good tool for this kind of work, it is far from being quick and accurate. The accompanying drawing represents a hand-broaching machine that can be cheaply gotten up and take care of work of this kind. This tool can cut small keyseats three or four times faster than a shaper or a keyseater and do the work accurately and neatly. This tool will not cut keyways much larger than ¼ inch or keyways much longer than 2 inches by hand. For small face gears and pulleys this tool would be very valuable. The tool can also be used for broaching square, hexagon or other odd-shaped holes.

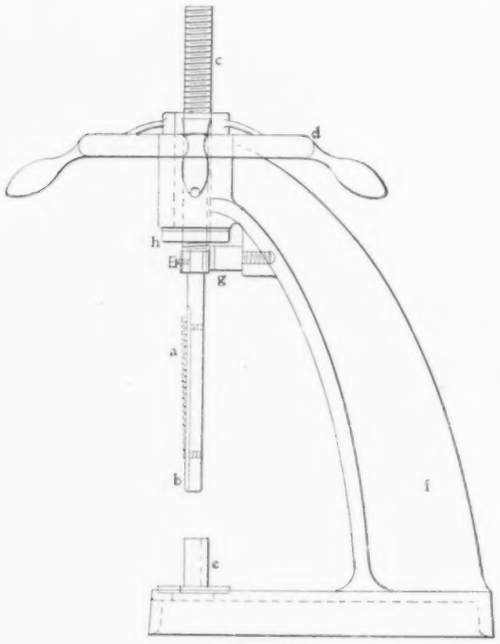


FIG. 1

A HAND BROACHING MACHINE

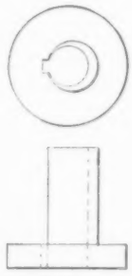


FIG. 3

FIG. 2

The general construction of this tool is shown in Fig. 1. It consists of cast-iron housing *f*; the top of this is a bearing, and in this bearing is a nut *h*; at the top of this nut the large hand-wheel *d* is secured for revolving the nut. Through this nut is the screw *c*. This screw is splined and slides into the key *g*. This key prevents the screw from turning and the revolving of the hand-wheel *d* feeds the screw up or down, depending in what direction you are turning the hand-wheel. At the bottom end of the screw there is a hole, in which an arbor *b* is securely held by a small set-screw. This arbor is made in three sizes, one being about 9/16 inch in diameter; in it there is a long broach *a*, ⅛ or 5/32 inch wide. The next size is about 11/16 inch in diameter; this arbor holds a broach 3/16 or 7/32 inch wide, and the largest arbor is about 13/16 inch in diameter, holding a broach ¼ inch wide.

These broaches must be securely held so they do not have a tendency of buckling or pulling out while in operation. Fig. 2 shows my idea for holding the broaches securely. The arbor has a dovetail spline in it and the broach is milled so it slides into this spline; to prevent it from falling out there are two screws through the arbor pressing against the back of the broach.

To cut keyways in gears or pulleys with different size holes I use the eccentric bushings *e*, as shown in Fig. 3. The holes in the bushings are the same size as the arbor so the arbor can slide through freely. The outside diameter of the bushing that is turned eccentric to the hole is the same diameter as the hole in the work that's to be keywayed. On the bottom of this bushing there is a flange; on this flange the hub of pulley or gear rests. Through the flange there is a keyway the same size as the broach. In the base of the tool there is a counterbore the same size as the flange; this counterbore is in line with the arbor so when the bushing is placed in it and the hand-wheel revolved the arbor will pass through the hole in the bushing.

It is unnecessary to clamp your work, as the broach in cutting it presses the work against the flange of the bushing. As the broach passes through the work it slides through the key in the flange of the bushing, and due to there being no space beneath the gear, the broach cannot tear out the metal around the key as it usually does in the old process of broaching keyways. If there are square or hexagon-shaped holes to broach and it is not necessary to take out very much metal a broach can be made to suit the size hole. Then a round plate the size of the flange on the bushing can be made with the size hole to suit the broad cut, through it. The work to be broached can then be placed on plate and the broach fed slowly through it.

The estimate of the gold produced in the United States during last year by the director of the mint is $89,620,399, against $94,393,800 in 1906. The output of gold from the Transvaal in 1907, according to the London journal *South Africa*, aggregated $133,360,292, against $119,618,507 in 1906, and $61,265,575 in 1903.

Building Automobiles in New York City

Some of Tools, Fixtures and Methods Used in Securing Accuracy and Interchangeability in Building Motor Cars

EDITORIAL CORRESPONDENCE

Automobile building affords many opportunities for the display of mechanical ingenuity in the design of jigs, tools and other appliances, and Mr. Franquist, superintendent of the Simplex Automobile Company, East Eighty-third street, New York City, has grasped the situation and made much of the opportunity as the illustrations will show.

The very ingenious drilling and tapping device shown in Fig. 1 was made to locate the holes for the water-jacket covers on the cylinders made last year and, though it is not now necessary as they are able to obtain good castings with the water jacket and cylinder in one piece, it ought to be useful for other purposes. It is self-contained, the stand being moved anywhere so that the motor can be connected to a lamp socket. The cylinder is set behind a plate carrying bushings for each hole to be drilled. The drill can be adjusted vertically through the arm by the hand wheel shown and, as the motor is at the bottom of this column it does not in any way affect the drive. It can also be turned in this bearing so as to secure any angle in a horizontal plane and handles very easily as it is counter-balanced at the back as shown. At the top of the cylinder is the tapping head which goes in place of the drilling head when the holes are ready to tap. The whole thing is easily handled and a boy can drill and tap holes at a very rapid rate.

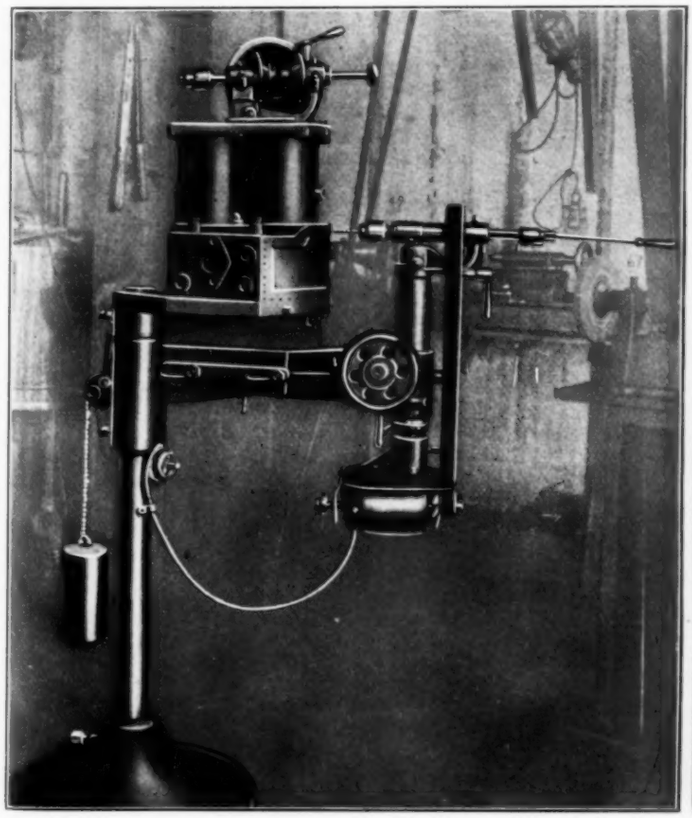


FIG. 1. UNIVERSAL DRILL AND JIG

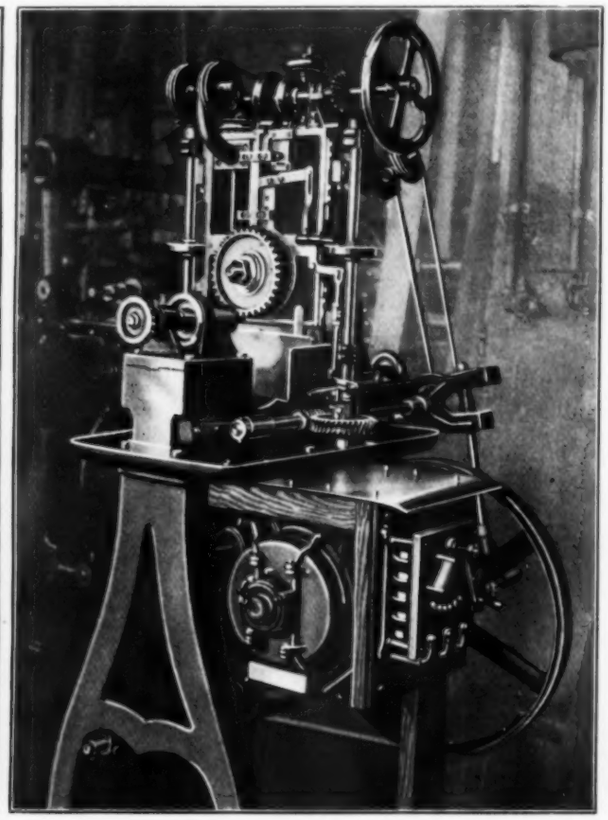


FIG. 2. ROUNDING ENDS OF GEAR TEETH

Rounding Gear Teeth

In Fig. 2 is a very ingenious machine for rounding the ends of gear teeth for the transmission so they will slide together easily. The gear is mounted on the plate at the back and is self-indexing by the stop at the top of the gear. When the gear has an odd number of teeth a prong stop that goes over the tooth centers it in the same way. The gear is fed down to the small cutter which can be seen at the bottom, driven by the belt and adjusted endwise by the handle, by the cam above. The same cam-shaft, driven by the bevel gears from the worm and wheel, also feeds the gear down to the cutter to the right depth, returns the blank, raises the stop out of the teeth and indexes the gear one tooth. This also tests the accuracy of the gears as it is so adjusted that the machine stops when the tooth stop fails to enter properly into the tooth space, so that it detects either a thick or a thin tooth. Like the drill it is driven by an independent motor which, with its controller, is shown beneath the table.

A Thread-milling Device

A very efficient thread-milling device is used to thread the caps for the valve chambers and is shown in Fig. 3. Two of the caps are shown on the lathe carriage at the left, and as will be seen, are of cast iron and cored on the back. The narrow rim slips into a spring chuck and is held in place by a blank center in the tail stock. This milling device is driven by an independent motor fastened to an extension of the carriage and driving the thread-milling cutter by worm gears at a reduction of 20 to 1, giving a cutter speed of about 80 revolutions per minute. The cutter spindle is carried in a central bearing so that it can be inclined to any thread

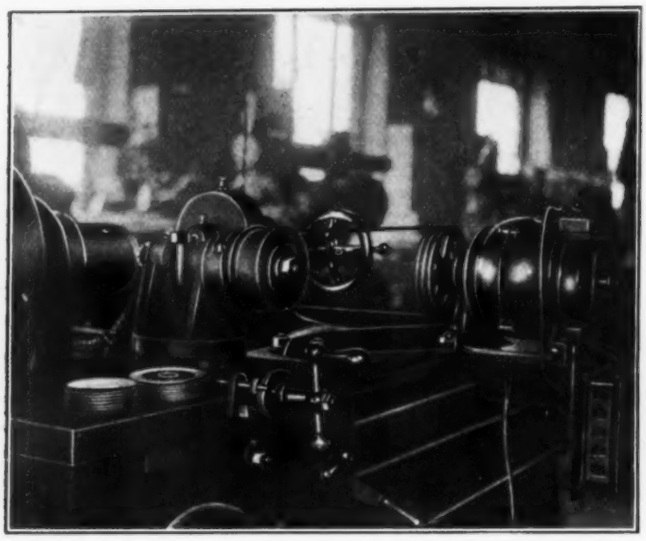


FIG. 3. MILLING THREADS IN A LATHE

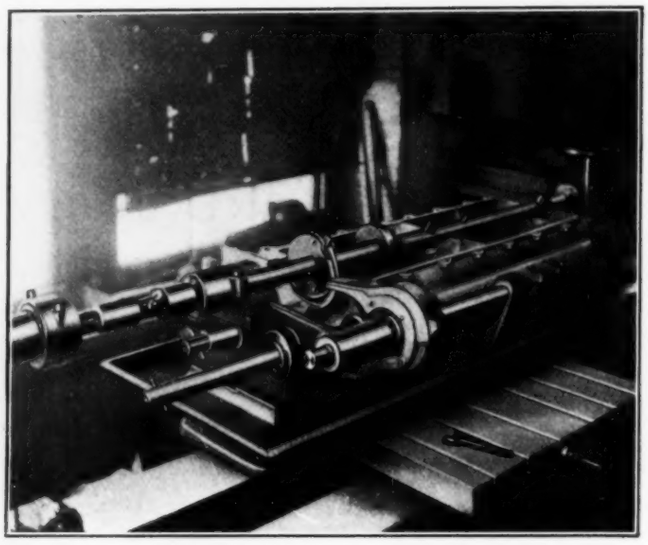


FIG. 4. BORING CRANK CASE

angle desired. The caps are 3¼ inches in diameter, 6 pitch and are threaded complete in about 6 minutes.

Fig. 4 shows the very complete boring method for the crank cases which are of aluminum bronze. This fixture carries the whole crank case and holds it firmly in position while all the various holes are bored by their own bars. To do this the whole fixture is shifted by moving the cross-slide and raising the knee so as to bring each bar approximately in line with the boring-machine spindle. Exact centering is unnecessary when the double universal-joint connection is used as is now very common. Each bar is driven by the pins shown and a clutch arrangement which Mr. Franquist uses very extensively and which will be shown in detail later. The various bars are so located as to bore all the holes in their correct position with relation to each other.

The center bar shown connected up for boring, is facing the ends of the center and also of the right-hand end bearing. The large cutter at the left is cutting a groove in the opening, the cutting tool being set out by the wedge or key shown between it and the collar at the right. This key is tapered and is tapped in slowly until the head comes against the right side of the collar, when the cutter is set out to cut its full depth.

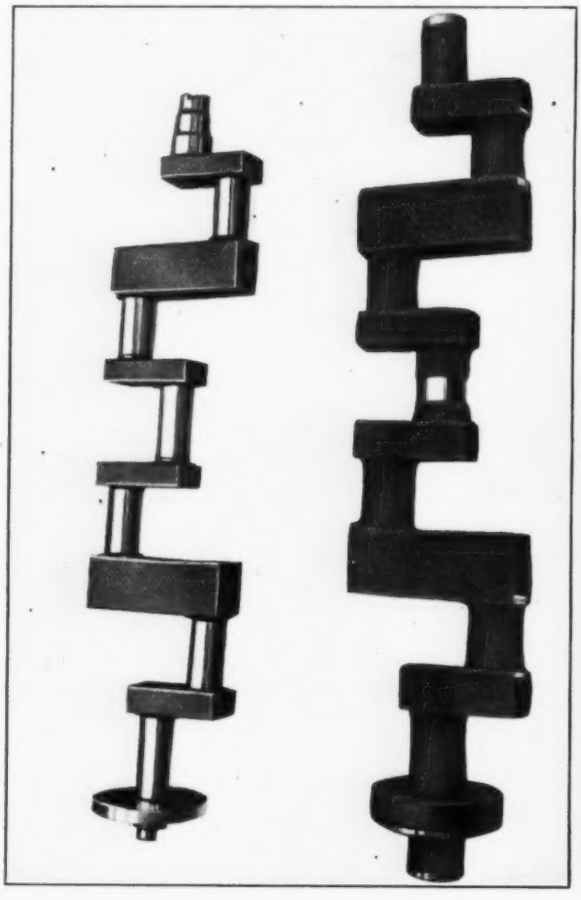


FIG. 5. THE CRANKSHAFT BEFORE AND AFTER

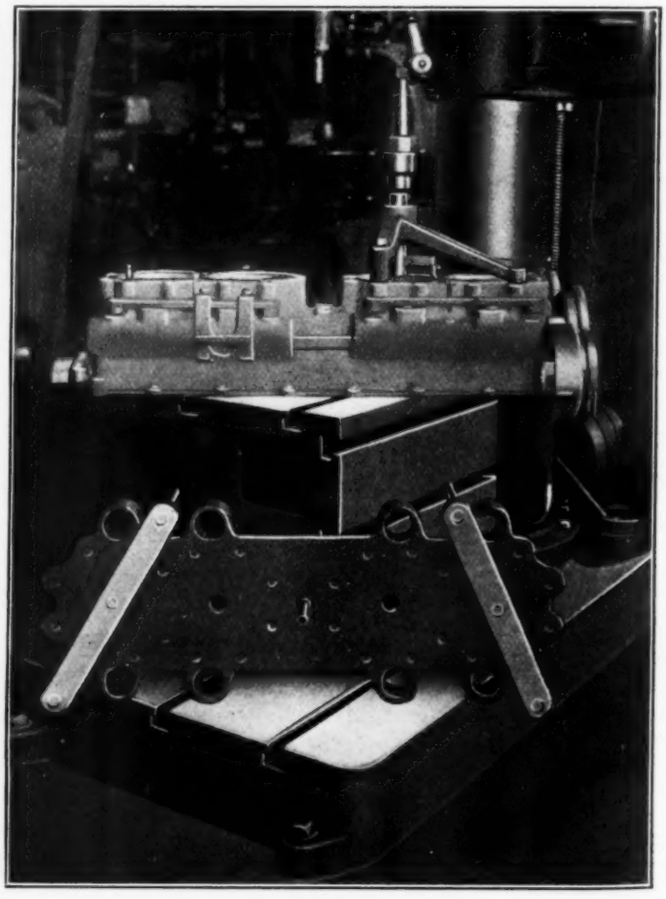


FIG. 6. DRILLING THE CRANK CASE

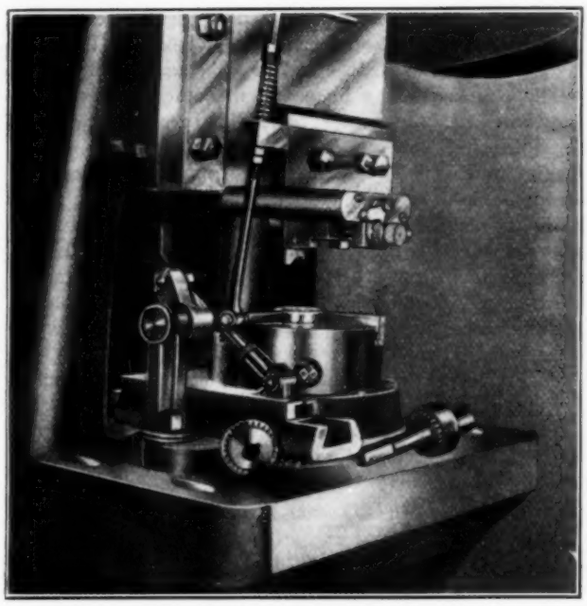


FIG. 7. CUTTING INTERNAL CLUTCH GEARS

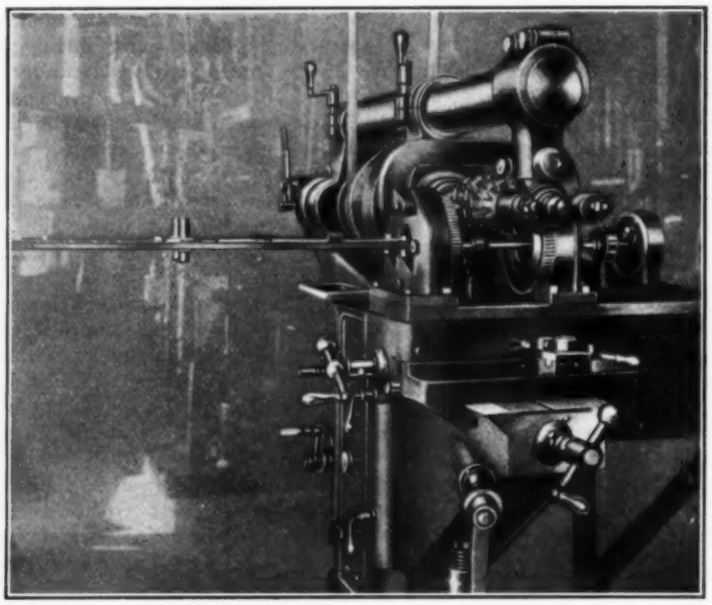


FIG. 8. MILLING THE CAM SHAFT

The facing cutters are set on an angle of about 30 degrees, but as this feature is shown more clearly in another view, the reasons will be given later.

The Crank-shaft

An example of before and after taking a course of machine treatment is shown in Fig. 5, where a rough forging and a finished crank-shaft are shown side by side. These forgings are of chrome-nickel steel, and come from Krupps' works, at Essen, Germany. They are not particularly attractive looking forgings, being rougher than we are accustomed to see, but this is probably accounted for by the fact that Krupp takes an order for such a shaft as this in lots as low as 50 each at a price that would be out of the question if dies had to be made, as is our custom for nice drop forgings.

While we have no inside information as to their methods, it would seem as though they cast the dies, probably of steel, instead of machining them out of steel, as customary here. These forgings weigh about 153 pounds in the rough and only

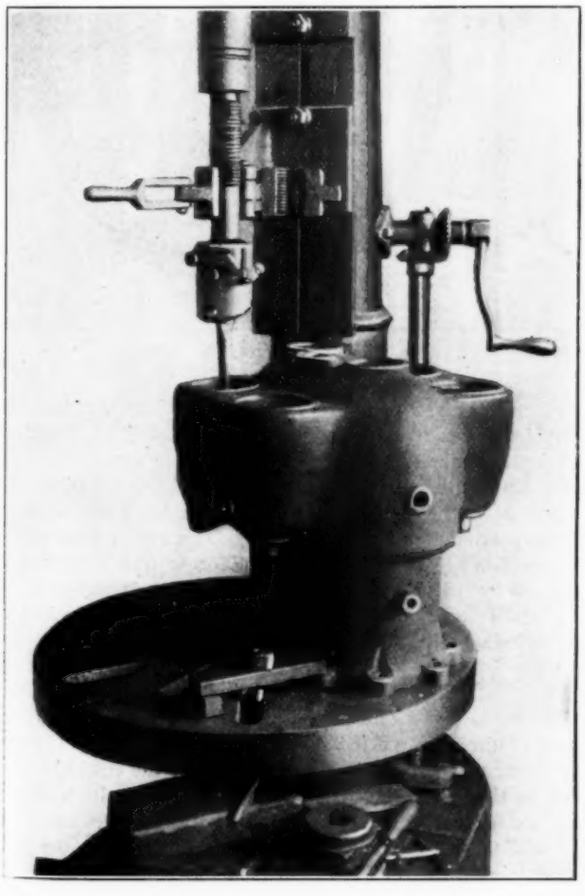


FIG. 9. THREADING IN THE DRILL PRESS

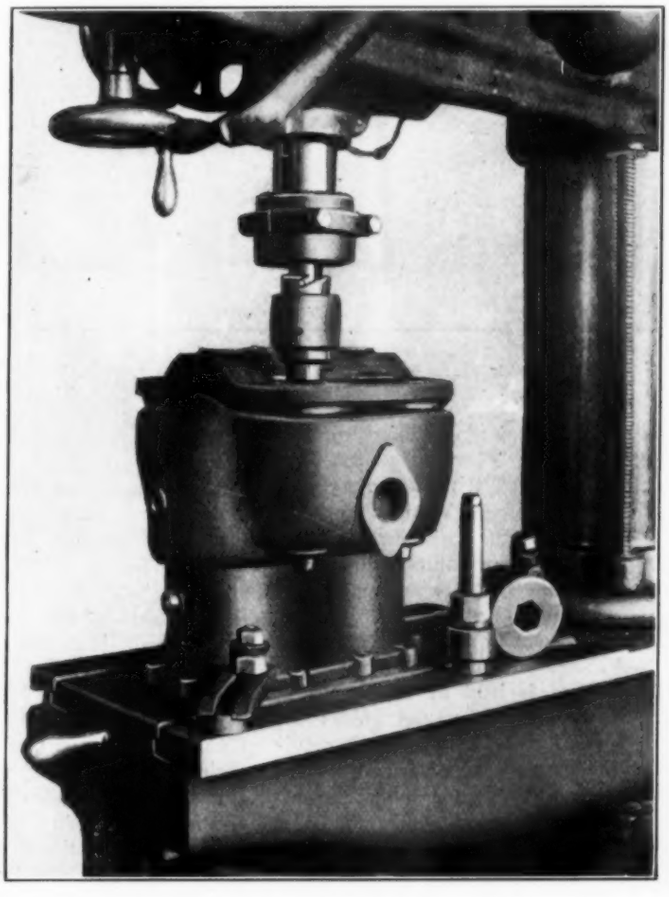


FIG. 10. METHOD OF DRIVING TOOLS

60 pounds after being finished for the engine. They are drilled through two of the cheeks to reduce weight, while leaving much of the stiffness, and while not finished by any special method, are carefully turned, shaped, ground, and the bearings are all lapped. The bearings are of a hard, white metal that scrapes down very nicely and wears well.

Drilling the Crank Case

Some idea of the jig system can be obtained from Fig. 6. The crank-case casting which was being bored in Fig. 4 has now come to the drill press for the drilling and boring. This is all worked from the center of the casting where a hole is drilled and the jig shown in front placed over it. The central stud or bushing is located over this hole by a test plug, the ends of the jig centered sideways by the swinging arms at each end by swinging them until they bear against each side, then the jig is clamped down, the end arms removed, and the drilling proceeds.

The eight large holes at the sides form guides for the smaller supplementary jigs, shown in place on the casting, plugs on these going into the large holes bored. This gives a complete drilling of the crank case, and all the holes are in proper relation to each other.

The large cylinder holes are bored by the tool shown in place at the right. The spider casting is held by cap-screws in four of the bolt holes and guides the swing-boring tool. By reversing the spider the boring tool is located for the other hole and the whole thing is transferred to the other end where the other two cylinder holes are bored.

Cutting Gears in a Punch Press

Utilizing a crank press to cut internal gears is a little out of the ordinary, but the device shown in Fig. 7 works to perfection and is decidedly ingenious in every way. The gears are really clutch cases, but they have all the attributes of internal gears except the teeth, which are square. One of the couplings is shown in front of the device and another internal piece at the side. This is the coupling that drives the magneto for furnishing the spark and it gives a positive drive with as much flexibility as needed by allowing play in the teeth, while it also affords a means of setting the magneto armature at any desired position in relation to the engine connection. There are 25 teeth so that the adjustment is quite close.

The illustration shows how the tool crosshead is fastened to the ram and the tool fed across or into the cut, by the cross-feed screw. Each down stroke takes a cut with the small, formed tool which is in a regular clapper box, and moves the turning ratchet through the bell crank and rods shown. On the up stroke the ratchet returns and turns the chuck one tooth space. This is repeated until the first cut is complete all the way around, the tool fed in and the operation repeated. A good boy will operate this very successfully and cut a complete gear or clutch in three minutes, including all setting and adjusting.

The Cam-shaft

One of the important parts of the gas engine is the cam-shaft. The cams must be cut at the right angles so as to time the opening and closing of the valves correctly. To cut these, the milling machine shown in Fig. 8 has been rigged up for this work. First are the two carrying frames tied together by the overhead brace. These frames carry three jawed chucks for centering and holding the cam-shafts, the right end being held in the indexing plate and the other supported by the center screw between the two flat braces extending out to the left.

There are two forms to be milled, the large round on the bottom of the cams and the smaller round and sides of the business end. Two sets of formed cutters are put on the milling-machine arbor and after milling one side the table is moved on the knee to bring the work under the proper cutters.

To help keep this straight the small screw jack shown is set under the cam being milled and the work supported firmly during the cutting operation. This turns out a first-class job in very good time.

Threading in the Drill Press

The caps being threaded with a milling cutter in Fig. 3, screw into the cylinders at the openings shown in Fig. 9. This is too large a hole to tap comfortably so the threading device shown in place was made and ought to find a place in many classes of work. The arm bolted to the face of the drill press has a plain half bearing and a threaded half nut which is hinged to the arm and can be locked by the latch shown open.

The business part of the apparatus is the threaded spindle which goes into the drill-press spindle, the feed being disconnected so it can move freely.

The tool head carries the cutting tool at the angle necessary to have the back end clear the outside of the hole when the point is breaking through inside the hole.

The guide on the end goes into the valve-spindle hole, the tool is brought down to about the starting point, the half

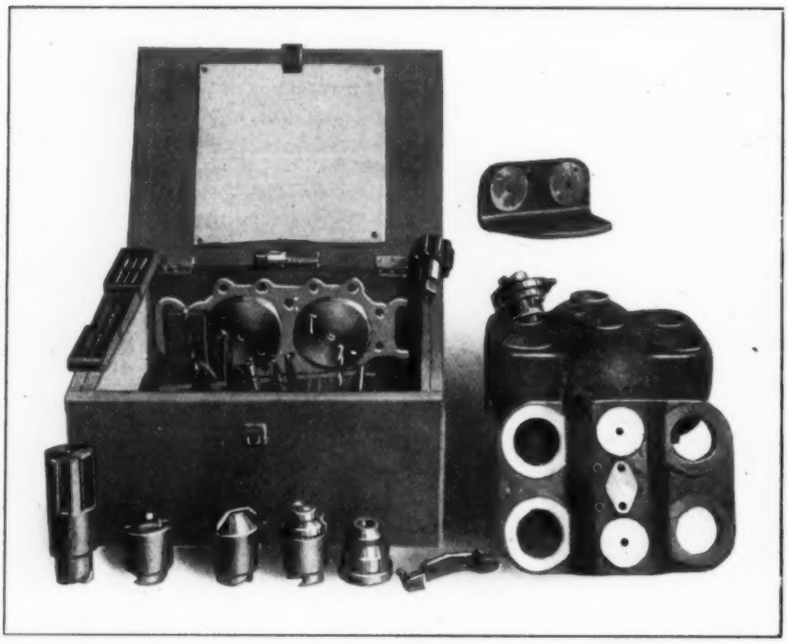


FIG. 11. A BOX OF CYLINDER TOOLS AND FIXTURES

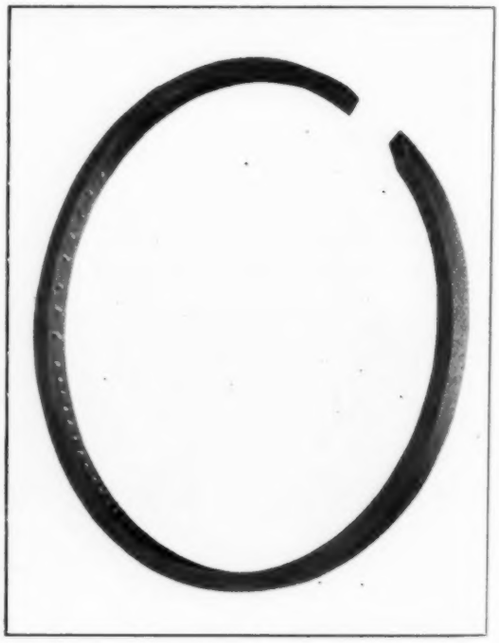


FIG. 12. THE PISTON RING

nut locked on the spindle and the drill started. The tool feeds down at the same rate as the thread of the spindle and when the tool is through the screw-head under the lever, bears on the face edge of the hole and trips the tool so it withdraws into the body. The half nut is opened, the spindle raised, the tool fed by the screw at the back, the lever brought down to its proper position, the half nut closed and the next cut taken. In this way the holes are threaded and, although it takes some time in the telling, it is not as slow an operation as might be imagined.

The Way Tools Are Driven

Tang failures of drills and boring bars have evidently left their impression, because they are not used in any case for driving. Instead the driving collars in Fig. 10 are made in halves and clamped tight to the nose of the spindle by the drawing bolts. The mouth of these are made hexagon, as can be seen from the one on the table beside the drill chuck, and while the tools fit the taper of the spindle as before, the driving is all done by the hexagon instead of the tang. In addition to this they use the pin-clutch drive as can be seen in several places. It is an adaptation of the bayonet joint in which the end of the driving arbor is tapered, and the incline on the driven end of the tool forces the taper into place, centers it and makes a substantial drive. This view shows the jig in place for locating the valve-cap holes.

The Tool and Jig System

Each drilling or other job which requires the use of jigs and tools has a tool box all to itself as shown in Fig. 11. These are substantially made, have a list of the tools and jigs that belong with it on the cover and are provided with a padlock. The box shown is for the cylinder work, part of the tools and fixtures being shown outside the box. Boxes are provided for the smaller taps and each drill, reamer and counterbore has a special place in the box so that the operator or inspector can tell at a glance what tools, if any, are missing. The boring heads are all driven by the clutch or pin method before described, the top cylinder jig is in front of the cylinders, the bottom jig in the box at the back and above is a fixture in which the two raised spots go into the counterbore of the valve holes while the angle or wing carries the bushings for locating side holes.

The box system seems to be growing in favor in spite of the large increase in the number of tools necessary, for as many ½-inch taps and drills have to be provided as there are jobs using them and the same is true of all other tools and sizes. Still it saves time, keeps drills and taps in better shape and has many advantages.

The Piston Rings

The piston ring is made a little different from the usual way although they are bored, turned and cut off by much the same methods as in other shops. After being rough turned and cut off they are sawed at an angle of 55 degrees. The next operation is peening, as can be seen by the marks inside the ring and this is done by hand with a ball-peen hammer, the ring in question showing very even blows, spaced a little farther apart as they go from the center toward the ends.

Then the ends are carefully fitted together, the sides of the ring ground on a little Heald grinder, the ring sprung together and wired for holding the ends while about a dozen are being placed on an arbor with the usual clamping collars at the ends. It is then turned down to within a grinding allowance of size and finished by grinding in the usual way. There is no eccentricity to the ring and the peening gives it a good tension which is said to be more lasting in actual service than can be obtained in any other way.

Some of the Jigs

Figs. 13 and 14 show a few of the many nice jigs in use on this work, the top row showing those for the steering knuckle. This knuckle is a drop forging as shown in *A*, Fig. 15, and which has been turned and threaded on the portion going inside the wheel hub. The rest of it bears little resemblance in looks or weight to the finished product at *D*, Fig. 13. Then the cross hole is bored and recessed as shown at *A*, Fig. 5, by a boring tool. The large center hole and six small holes are next drilled along the center line at *B*, Fig. 15, and two saw cuts at the end of these holes detach the upper part entirely from the rest, leaving this open as shown at *C*. The cutter *D* is then inserted in the boring bar at the recess and the bar fed across the opening until the recess extends the whole length of the opening and the knuckle assumes the appearance of *C* except for the turning and thread of the shank or bearing. This, however, is plain sailing as com-

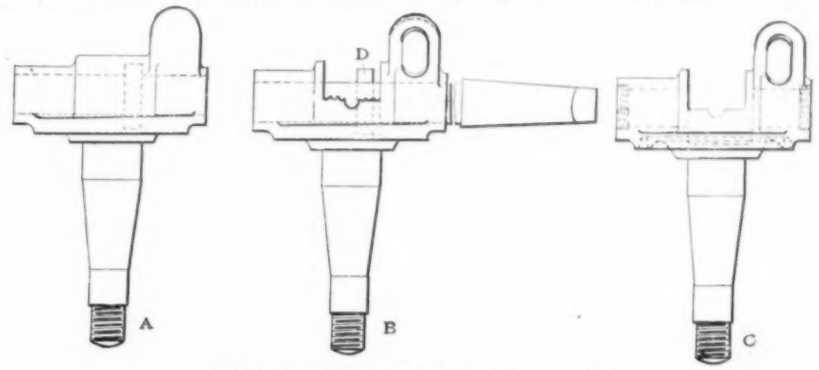
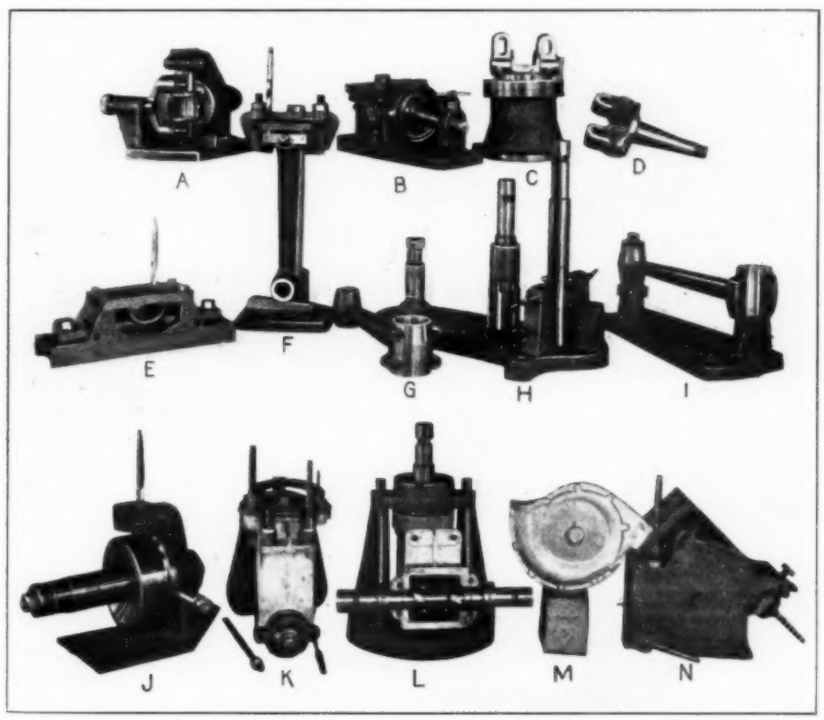


FIG. 15. BORING THE STEERING KNUCKLES



FIGS. 13 AND 14. SOME OF THE JIGS

pared with the recessing already accomplished.

For reaming the end bearings of the knuckle it is put in the jig *A*, Fig. 13, the wings evened up by the fork at the left, held from turning by the small screw at the bottom and the rest is easy. The oblong angular holes are drilled in jig *B* which allows the knuckle to be swung so as to get the proper angles, these being reversed in the two ears. Jig *C* tests the alinement of the various holes and bearings.

The Connecting Rods

Jigs *E* to *I* get the connecting rods into alinement and locate all holes. At the left *E* looks after the caps which are located by the raised or rabetted edge on the box fitting into the upper plate, the cap being held in place by the two lever clamps underneath, hinged as shown and forcing the cap up against the bushing plate. The corresponding end of the connecting rod is handled in jig *F*, being located by drawing up against the bushing plate and back against a stop on the upright. The thrust of the drill is taken by the wedge under the bottom of the rod.

Jig *G* locates the rod by the plug at the left while the screws at the right adjust the large end, with the cap, for boring out the bearing. The roughing bar is shown in place and the reamer behind finishes the bore.

The next jig *I* in reality follows the boring of the small hole as it is to locate the recesses in the end of the rod for the cap which takes the side strain from the cap-bolts. The cutters are set by the partially milled groove below the rod itself, and the rod milled with no loss of time. The clamping bolt is omitted to make the recesses clearer, but goes in the center of the bearing and between the straddle mills used.

Jig *J* shows an easy way to locate alternate or zig-zag holes in the drum shown, by using every other index notch for one row of holes, then moving the work so as to use the other bushing and using the notches in between the first set.

Jigs *K* and *L* handle the steering-gear case, and while not unusual, are very complete. Wedge keys hold the top plate on *L* and the boring bar shown horizontally gives a better idea of the facing cutters mentioned in connection with Fig. 4. The holes for these are mortised through the bar at an angle of about 30 degrees, the ends of the mortise being just enough out of square to give the desired top clearance. These cutters are held with a taper pin and can always be set to the same position as they are sharpened by grinding only on the front edge so that they move forward as they are ground away.

The casing for the centrifugal circulating pump is shown at *M*. Both halves are put into the jig after being faced for the joint, located by the central pin in the hole for the fan or impeller shaft, the bushing plate put over the studs and held in place by the taper keys. The position of the drills at the ends shows how the inlet and outlet connections are drilled when the jig is turned over on the different faces.

A Cheap Butt Mill for Brass Fittings and Similar Work

By Ethan Viall

In the manufacture of brass valve bodies and other brass plumbing goods and fittings which have hexagon wrench holds for the purpose of screwing them into place, it is necessary to have some means of machining these hexagon surfaces to certain standard sizes. A special milling machine is made for this purpose.

Fig. 1 shows one of them with a brass cock body ready to be run past the cutters which mill four surfaces at once; two on opposite sides of each end. The cock body is held by means of a pneumatic plunger which presses it down on the lower plug. After the cock is fed past the cutters it is drawn back and indexed by means of the handle *H*. When finished, a turn of the air-valve handle *K* instantly releases it. In the machine shown the indexing and feeding are done by hand, but a machine that does this automatically is being installed.

As all kinds of brass, old and new, are used in making these fittings, hard scale and spots of iron are very frequently met with. These invariably dull or break the tools. On this account a butt-mill which is cheap to make, easy to sharpen and with a reasonably long life is absolutely essential to economical production. In the butt-mills shown in Fig. 2 all of these conditions are met. They are satisfactory and are not only good for use in the hexing machine but also for many other jobs.

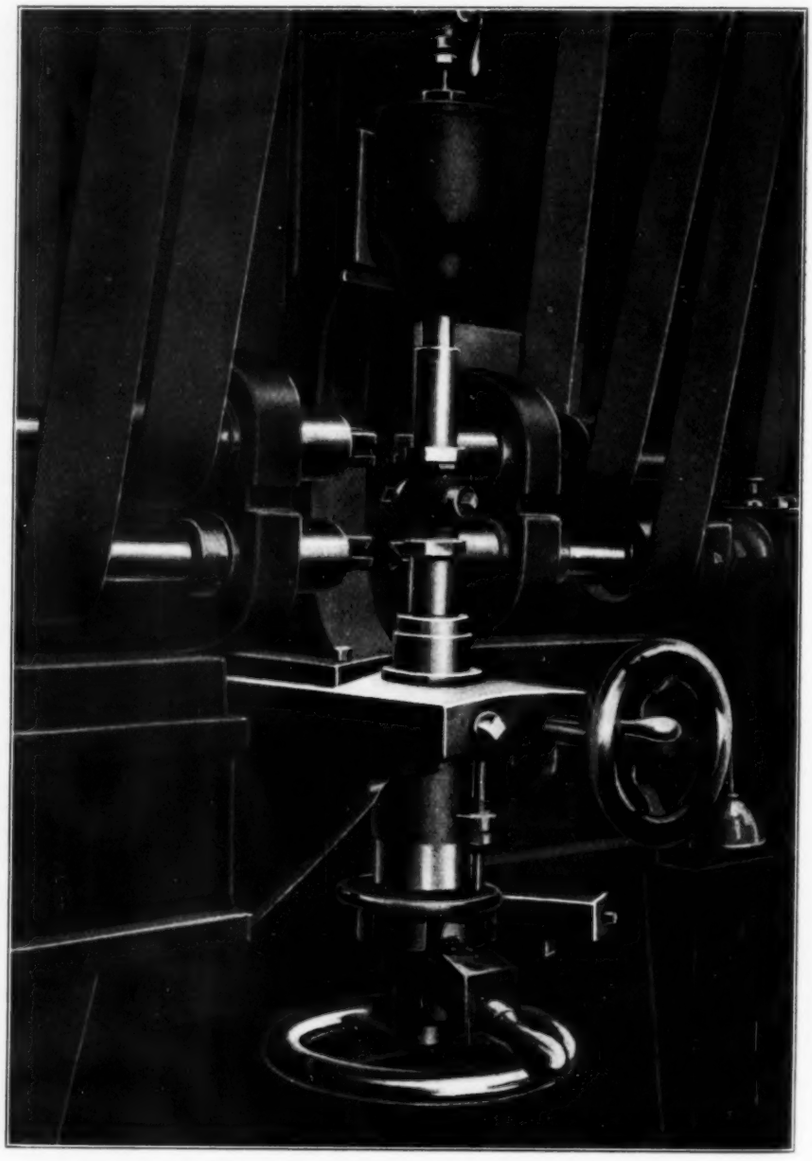


FIG. 1. MACHINE FOR HEXING VALVE BODIES AND FITTINGS

The mills are made from square stock, cut into lengths a little more than twice as long as the finished mill. These are centered and the shanks are turned to size and length on each end. They are then milled. The result is something like the mills shown at *E*, Fig. 2. They are next cut in two; the cutting end is hollowed slightly; the blades are relieved and they are hardened and ground. This

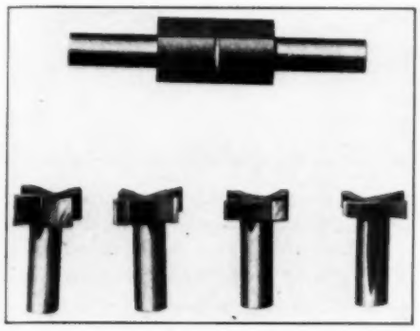


FIG. 2. CHEAP BUTT MILLS FOR HEXING

way of turning and milling gives a right- and left-hand mill with the least possible trouble in machining. The mills shown set end to end at *E* are nearly new, while *A*, *B*, *C* and *D* are mills that have been in use from one to two years.

Fig. 3 shows how the cutting edges of these butt-mills are ground when dull. The jig used to hold them is a regular stock jig used for holding work of various kinds. The butt-mills are not clamped tightly in this fixture, but are free to be revolved by hand; the spring stop holds them in the right position.

Fig. 4 shows how the center is ground in order to give the proper clearance as the cutting edges wear back. A rather soft, coarse-grained wheel is used for this work. The hollowing is done very rapidly with scarcely any heating.

Fig. 5 shows the ends of a right- and left-hand mill after they have been ground and are ready for use.

The Manufacture and Upkeep of Milling Cutters

By W. H. Booth

In the course of a paper read before the Institution of Mechanical Engineers, in London, by Dr. H. T. Ashton, of the Small Arms Factory, of Enfield, which was published in the American Machinist of March 26, the author remarked that various difficulties as to accurate finish and a good surface had hindered the employment of high-speed steel for milling cutters of complicated shape. But the sight of the cuts taken with high-speed steels, the way tools maintain their edge at high speeds and generally the behavior of such steel cannot but offer inducements to have it tried for milling cutters, for though the exigencies of finish may preclude any great increase of speed and feed there is the important saving effected in the cost of the tools themselves, for a milling cutter has its cost made up rather of labor than of material in a greater degree than any other tool, and a small increase in life of a cutter will outweigh any additional first cost in its material. The minimizing of first cost and upkeep and the maintenance of continuous output of the machines depend upon the quality of steel from which they are made, the method of hardening adopted, the care and accuracy with which new cutters are made and the facility and correctness with which a cutter can be ground when dulled. No difficulty is now experienced with high-speed steel as a material for cutters nor in obtaining a sufficiently satisfactory finish so long as care is exercised in grinding and finishing the cutters and fixing suitable feed and speed, and any of the best known brands of steel can be used with the system described.

FIG. 5. ENDS OF BUTT MILLS AFTER GRINDING

Annealing Process

The cutters are annealed when packed in spent powdered charcoal and steel turnings in cast-iron pans with luted covers. These boxes are put into the annealing furnace at the beginning of the day and heated to 700 degrees Centigrade or 750 degrees Centigrade. This is reached by 1 p.m. and maintained until 5 p.m., and the furnace is given 48 hours to cool down. The cutters are hardened in a coke-fired furnace with a forced draft. A temperature of 2300 degrees can be obtained. The cutters to be hardened are packed in powdered charcoal in steel boxes measuring 6x6x3 inches, and they require 2¾ to 3 hours to attain the necessary temperature, according to the weight of metal to be heated. The temperature required is 2000 degrees to 2100 degrees Fahrenheit, according to the nature of the steel, and this has been previously determined by laboratory experiments, the furnace temperature being checked by a Fery Radiation Pyrometer tested against a standardized calendar pyrometer. When sufficiently heated the cutters are quickly taken out of the packing and placed on the hardening table. Air is blown upon the cutters as they rotate on a spindle also rotated by the blast of air. The air is drawn from a wet culvert and is always cold and damp and possesses a maximum cooling effect. The temperature of hardening or of the preheating are such that the cutting edges are nearly fused as a general rule, but the fusing is minimized by the system of heating in closed boxes which also minimizes the scaling which attends in ordinary heating method in either muffles or direct gas flame. The holes in the cutters are small and expand slightly when the cutters are hardened,

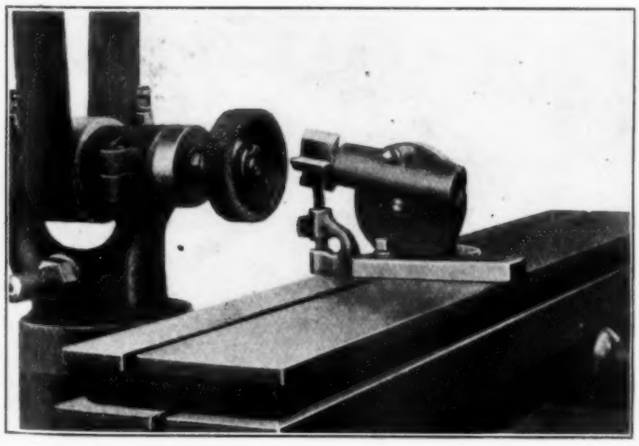


FIG. 3

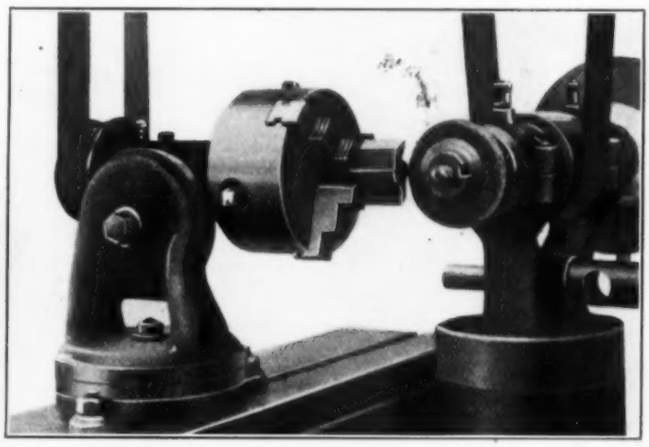


FIG. 4

GRINDING OPERATIONS ON BUTT MILLS

and they are brought to size by internal grinding, being chucked by the outside diameter in a self-centering chuck, after which the teeth are finished. The teeth are then re-formed.

Finishing Cutters

Backing off is done by means of a spirally-slotted sleeve on the same spindle as the cutter, a simple method of correctly backing-off helical cutters in a third the time required on a relieving lathe. Cutters are ground first along the tops of the teeth and then down their faces, the wheel being set to the angle of the spiral of the teeth. The cutter is mounted on a dividing head, if straight, with the addition of the helical sleeve as above named for helical-tooth cutters. By the standardization of the pitches of the teeth and angles and the provision of suitable templets for each of the cutters commonly required the simple machines have been found to result in distinct economy both of cutters and quality of work done. Cutters are usually more damaged on the top than on the face and it has been frequently found that removing 0.002 inch from the top is equal to removing 0.006 inch from the face, and with the advantage that after sharpening a tooth on the face to its fullest extent it can be further sharpened on the top while still retaining its correct figure until the tooth is too short to allow the necessary clearance.

The life of cutters thus prepared has been very good; one which operated on the bodies of the service rifle in a Lincoln milling machine at an average speed of 60 feet per minute feeding 1¾ inches per minute at a depth of 0.08 inch, and taking a cut 1 11/16 inches wide and ⅞ inch long has produced 39,170 bodies and appears good for another 19,000 to 20,000. It has been ground on its face 25 times. The steel operated on contains 0.5 to 0.6 carbon and has an ultimate tenacity of 35 tons per square inch.

Gap Lathe for Patternmakers

By C. H. Fry

A patternmaker's lathe having several novel features is shown in the following illustrations which represent a new lathe recently built by the Oliver Machinery Company, Grand Rapids, Mich.

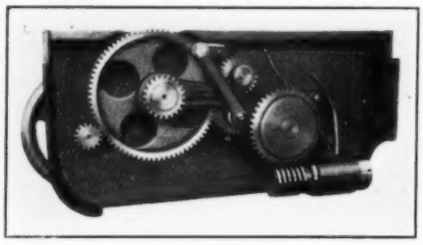


FIG. 2. GEARING OF THE CARRIAGE

Fig. 1 shows the lathe arranged for belt drive, but it is also built with a motor in the headstock.

The headstock cone on the belt-driven lathe has four steps, 7, 9½, 12 and 14½ inches diameter arranged with smallest pulley to the front of the headstock to allow more freedom of movement in working on the back of a face plate at that end. This is driven from a two-speed countershaft giving spindle speeds of 86, 125, 185 and 288 revolutions per minute on low speed, and 430, 625, 925 and 1440 revolutions per minute on high speed, giving a wide variation of speeds necessary for turning work from a 3-inch column between the centers to a 10-inch face plate on the rear end of the spindle, a 3½-inch belt giving ample power for the largest work. The spindle is hollow and runs in large babbitt bearings, the end thrust being taken up by means of a threaded collar and bronze washers working against scraped babbitt collars molded with the back bearing. The headstock rests on a raising block, which in turn rests on the lower bed, and may be swiveled sufficiently for ordinary work around a pin and set to the required angle by a finger at the rear.

On the rear end of the spindle is screwed the upper feed cone which is removed when work is to be done on that end of the spindle. From here the belt goes to the lower cone which is on a belt tightener in the rising block. Gears from this cone lead to a shaft which runs the full length of the lower bed for operating both the carriage feed and bed-moving mechanism.

The bed is made in two parts, the upper one sliding on the lower, allowing an opening 86 inches long in the gap, in which a diameter of 60 inches may be turned. For turning work in this gap a special carriage is provided which has a swivel slide, with a graduated base, compound feed of 31 inches which may be operated from either end by changing the handle. The cross-feed is 34 inches by means of the ball handle shown. The carriage is hinged at the back and when not in use is swung back and secured on a bracket behind the upper bed, allowing free use of the main carriage up to the headstock. The beds are both plain with the exception of the V for guiding the carriage on the upper bed. This is set below the top leaving a clear place for tools not in use. Under the V is fastened the steel rack which serves the double purpose of pulling the carriage and tailstock. The lower bed is cut back in front except at the three supports, to allow plenty of foot room for the operator. For supporting the upper bed, when the gap is open, there is an end leg with adjustable rollers running on a steel track, as clearly shown in Fig. 1.

The tailstock is of the massive open design with cored columns, and is moved along the bed by means of a crank and pinion, the pinion meshing with the feed rack. The 3-inch spindle is clamped in any position by means of a beveled sleeve

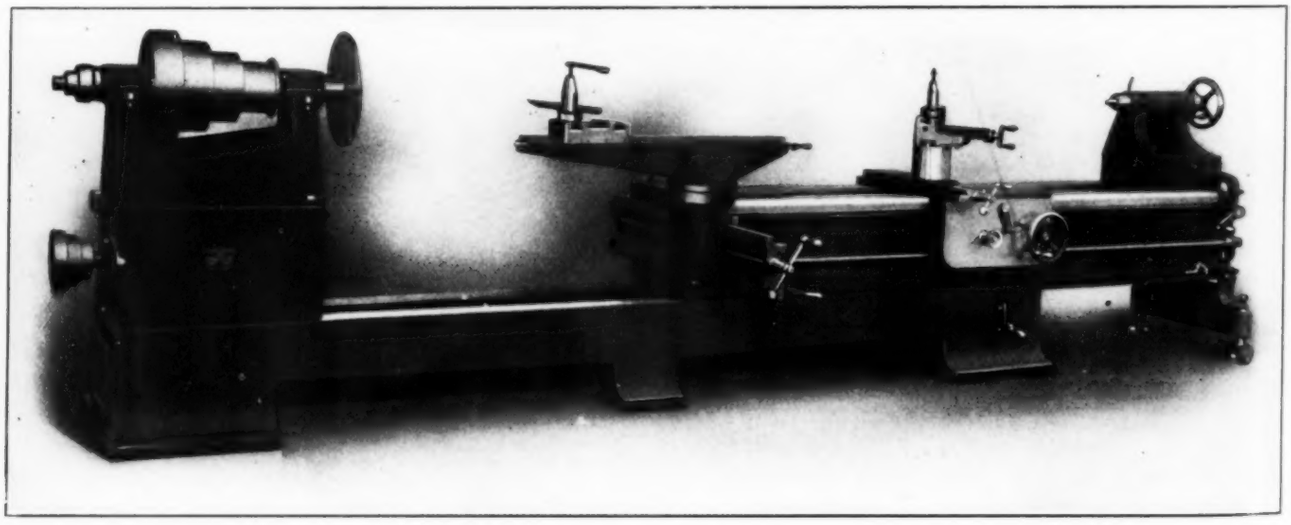


FIG. 1. GAP LATHE FOR PATTERNMAKERS WITH AUXILIARY CARRIAGE

and steel lever, thus doing away with splitting the bearing.

The main carriage is equipped with a power feed which may be used with the bed in any position, the shaft in the lower bed operating this feed. In the front end of the upper bed is a bracket reaching down and around the lower shaft and straddling a gear on the shaft. As the upper bed is moved, this gear with its key slides along the shaft and is always ready for use. A train of gears extend up to the bracket and mesh with the gear in the upper feed shaft on the outside of the upper bed. At this end also there is an automatic stop of the feed.

Fig. 2 shows a rear view of the apron which is very simple and yet very efficient. The entire mechanism is protected from dust by having the ends extend back to the bed, allowing only room for the feed shaft. The worm shown has a feather which slides in a keyway in the shaft. The worm gear is locked to the spur behind it by means of an efficient cone friction operated by a knob at the front. A three-gear reverse is used, as shown, being thrown for either direction of feed or neutral, for using the hand feed, by means of a lever in front. On the same shaft as the reduction gear is the rack pinion. At the extreme left is shown the hand wheel and its pinion which meshes with the reduction gear. The three-step feed cone gives feeds of 1/32, 1/16 and ⅛ inch per revolution of the spindle.

feed slide moves across the bed, a pin in the underside pulls out the cover, first the upper section and this in turn the lower section. The whole is closed back again by means of the feed-screw nut on returning the slide.

Fig. 3 shows the bed-moving mechanism before mentioned. This simple arrangement eliminates the former objections to gap lathes and is a great time and labor saver. The bed may be quickly moved a few inches or the full opening of the gap with no exertion on the part of the workman.

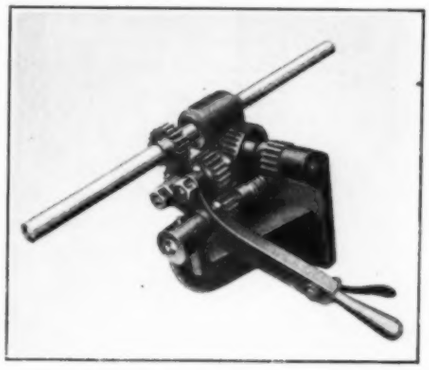


FIG. 3. GEARS FOR MOVING THE BED

The shaft shown runs along the inside of the lever bed as before mentioned. The usual three-geared drive is used so that the bed may be moved in either direction. The gear bracket swings around the shaft *B* allowing the idle gears to mesh with the gear *A*, thus having all gears idle when the mechanism is not being used. This fact overrides the advantage of having the reverse on the opposite or slower side of the speed reduction. The handle on the gear bracket extends through the front of the lower bed, as may be seen in Fig. 1, where the stop pin enters suitable stops for each position of the gears. The drive is then through the shaft *B* and the worm gears to the pinion *D* which meshes with a steel rack fastened to the underside of the upper bed.

Automatic Operation of a Milling-machine Knee

There is an interesting feature in connection with the two-spindle milling machine built by the Burk Machinery Company, Cleveland, Ohio, and shown at work on page 899, Vol. 30, Part 2, which we show herewith in detail. This is a device for automatically operating the elevation of the knee. Behind the knee, in the face of the column is a spiral cam shown at *A*, Fig. 1. This rests on a ball-thrust bearing below and is held in place by a dead center at the top.

This cam is not of uniform pitch, being coarser at the bottom than the top so as to move it rapidly when the work is away from the cutter, and to slow down the motion while the cut is under way. When the feed is reversed, the cam is speeded up to give a faster movement both in bringing the work past the cutter and after the faster pitch of the cam has been reached.

This cam is driven by the worm and gear, either by hand or through the feed drive from the cutter spindle. The knee is not mounted directly on the column, but on an intermediate plate which carries a roller engaging in the spiral slot of the cam. Assuming the knee at the lowest point and the work in place, the lever *B* has been depressed by dog *F* and lever *C* up against its stop pin as shown in Fig. 2.

To start the movement, depress lever *C* which throws in the clutch below and

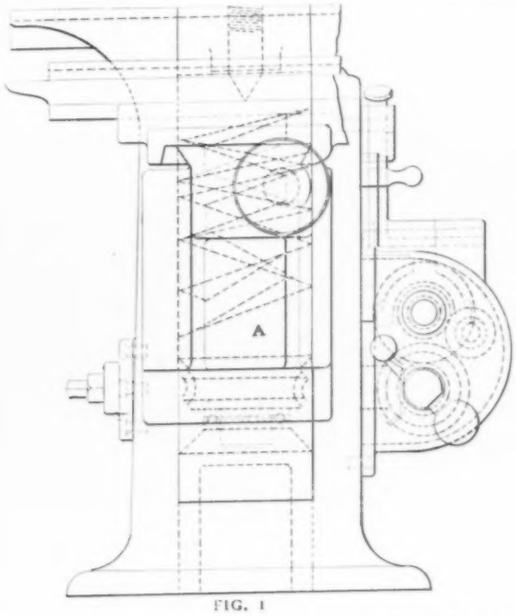


FIG. 1

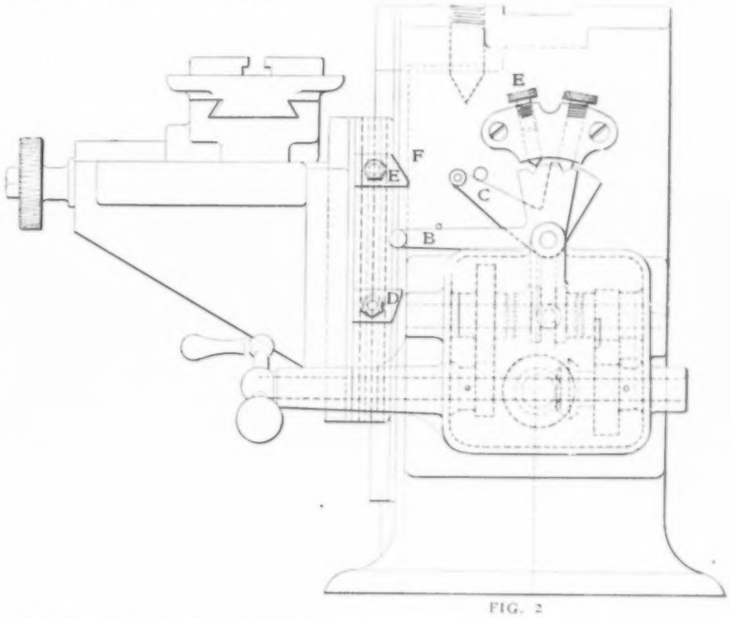


FIG. 2

AUTOMATICALLY OPERATED MILLING-MACHINE KNEE

The carriage is also provided with a hand cross-feed, swivel-compound rest and tool post which need no explanation. In the tool post may be used either specially forged tools, or a tool holder in which the patternmaker's regular tools can be used. A novel arrangement is added to keep the shavings out of the cross-feed screw in shape of a telescoping brass cover set into the carriage slide. As the

starts the cam, causing the knee to rise with the varying speeds due to its pitch. When stop *D*, on the intermediate plate, strikes lever *B*, it raises it and also the lever *C* which overlaps it. When these reach the point where plunger *E* starts to enter the V-slot in the quadrant, the spring behind *E* forces it into the slot and throws the clutch spool past the center so that it engages with the reverse clutch and the knee reverses, returning to its starting point.

Patterns for Special Pipe Flanges

By F. W. Barrows

In making up lines of piping composed of flanged fittings and wrought-iron pipe, reductions in diameter of the system are often made by the use of reducing flanges. A reducing flange is one having its outside diameter, thickness at edge, number of bolts and diameter of bolt circle, corresponding to the standard for the size (and grade) *from* which the reduction is made;

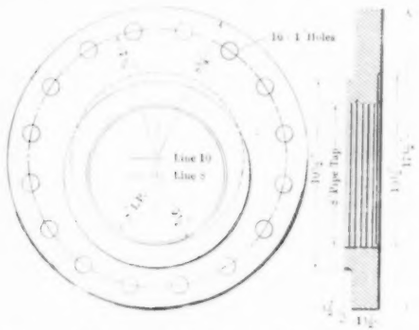


FIG. 1. 8 BY 17½-INCH EXTRA HEAVY ECCENTRIC FLANGE

while the hole is tapped for, and the hub made to suit the size *to* which the diameter of the pipe line is to be reduced.

Standards in Use

There are in general use at the present time two standards for pipe flanges, one graded for pressures up to 125 pounds per square inch, known as "Standard," and the other, called "Extra Heavy," used for pressures up to 250 pounds per square inch. All dimensions of these flanges are fixed by standards adopted by the manufacturers and steamfitters, except the outside diameter of the hub, as at *D* in Fig. 4, and this dimension can vary but little without encroaching on the bolt circle.

If the hub is central with the flange the order states, in technical terms, both the size for which the hole is to be tapped and the outside diameter; the two details, when supplemented by the standards in general use, being sufficient to give all the data necessary for the production of the required flange.

When the hole is to be tapped eccentric to outside diameter, it becomes necessary to fix the amount of this eccentricity. As the eccentric flange is usually so made for the purpose of bringing the inner surface, instead of the centers of the two sizes of pipe in line, this amount is determined by the inner radius of the piping. For example, an extra heavy flange ordered

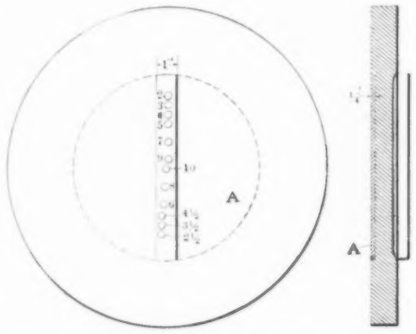


FIG. 2. PATTERN FOR 17½-INCH EXTRA HEAVY FLANGE

8x17½ eccentric (see Fig. 1), would have the 8-inch hole tapped 1 inch eccentric, this being the difference between 4 inches, the nominal inner radius of 8-inch pipe for which it is to be tapped, and 5 inches, the nominal inner radius of 10-inch pipe, which pipe is indicated by the outside diameter given in order.

Making a Flange

A very common way of making such a flange is to have the standard pattern fixed by putting a ring of the necessary dimensions in the pipe opening. It is possible to make this ring either concentric or eccentric, as the order demands, and when this "fixing" is carried to extremes, as might easily be done for some hurried order, the resulting casting is more useful than ornamental.

As there are but comparatively few of such flanges required, it rarely pays to

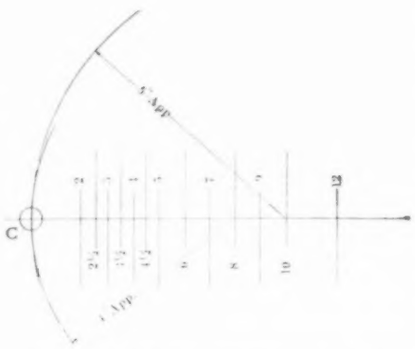


FIG. 3. SCALE FOR ECCENTRIC FLANGE

make a complete pattern for any one size, and they are often conspicuous examples of misdirected economy in pattern work. To produce such flanges, both eccentric and concentric, with as little pattern work as possible, and which should not have too much of the "natural growth" effect, I devised the plan illustrated below.

A scale was made as shown in Fig. 3, on which the distance from point *C* to 12 equals the inside radius of 12-inch pipe, *C* to 10 equals that of 10-inch pipe, and so on; each line being located by measurement from point *C*. It is evident that if a circle having the same radius as the inside of 10-inch pipe, be drawn about the intersection of line 10 with line *C*, the circumference will pass through point *C*, and if another circle with radius corresponding to inner radius of 8-inch pipe, be drawn about the point on *C* line marked by line 8, the circumference of this second circle would also pass through *C*. Thus the space between 10 and 8 on line *C* would mark the distance between center of 8-inch hole and center of 17½-inch extra heavy flange, as is illustrated by Fig. 1.

Method of Laying Out

A set, or rather two sets, of blind or blank flanges conforming to the above standards, and illustrated by Fig. 2, were laid out and the patterns started. After getting these well along some strips of pine, having a section about 1 inch by ¼

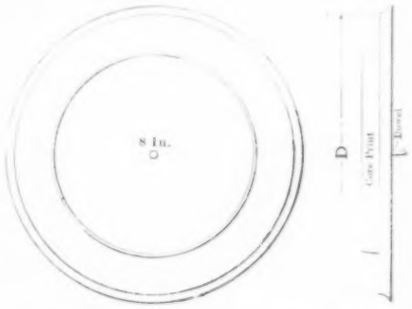


FIG. 4. PATTERN FOR 8-INCH HUB

inch and some 12 inches long, were sent to the brass foundry with an order for castings. These castings were fitted into the flat side of the flange patterns, as may be seen by referring to Fig. 2. The length of these brass strips was the diameter of recess *A*, and they were fastened in place by rivets through the extreme ends.

A center mark was then punched in the brass strip, central with the flange, and then stamped with the size for which the outside diameter was standard, that is, the extra heavy pattern which was 17½ inches diameter would be stamped 10 inches, as would also the standard weight pattern which was 16 inches in diameter.

From this center short arcs were scribed across the brass strips, marking the difference in radius of all sizes for which the pattern under construction might be used, i.e., from the size stamped at the center down to and including the 2-inch size.

This initial size was the point on scale, Fig. 2, from which the radii for scribing the arcs were taken by setting the dividers or trams to the space between 10 and 8 on line *C*, and transferring this measurement to the brass strip in the pattern for 17½-inch extra heavy, and also pattern

for 17-inch standard. Mark the line 9-inch, then transfer space 10-8 to both patterns, then 10-7, and so on down to 10-2, not forgetting to mark each line to correspond with the scale.

In order that the lines so made should not come too near together, each succeeding measurement was laid down on alternate sides of the center. Thus the sizes on 17½-inch extra heavy would read, beginning at the center, which is 10 and reading toward the top of Fig. 2; 10, 9, 7, 5, 4, 3, 2; reading toward the bottom, they are 10, 8, 6, 4½, 3½ and 2½.

When the entire lot had been laid off and marked in this way, additional rivets were put in between the lines and dowel holes drilled on the lines. For all lines marked with sizes 12 to 6, inclusive, this hole was ¼ inch. I had intended to use this size drill for all sizes, getting the necessary stock between the holes by staggering them, but in laying out the 11-inch extra heavy and the 10-inch standard, on both of which the center hole would be re marked 5 inches, the first reduction, 4½ inches, must be laid off from the center by a radius equal to the space 5-4½ on the scale. This space is approximately ¼ inch, and cannot be increased by staggering. I was therefore obliged to use a smaller drill (3/16) for all sizes under 6-inch pipe.

As our practice was to make the hubs of pipe flanges alike for both standards, only one set of hubs, each with its correct size of dowel pin at the center, was thought necessary. These hubs were made with the coreprint fast, as shown in Fig. 4, which is for an 8-inch hub.

Combination Patterns

It is evident that almost any combination could be made with this set of patterns, and I was pleased to think that my troubles with reducing and eccentric flanges were now over. If an order came in for an 8x19 standard flange tapped eccentric, the 8-inch hub was centered by the hole, in 19-inch standard flange, marked 8 inches, and the pattern was ready for the foundry. If the order was 8x19 standard flange, the 8-inch hub was placed in the central hole; again, if the order read 8x19 standard flange, tapped 1 inch eccentric, the hub was placed in the hole marked 10 inches, which hole is practically 1 inch from the center.

The facility with which these odd flanges could be made, each one as correct in every detail as though made from a special pattern, pleased all concerned.

It had been expected that the molder could assemble the flanges as he worked, but it was soon found that mistakes in locating the hub were very easily made, and the assembling had to be done in the pattern shop and results made certain by fastening the parts together.

A set of round, straight coreboxes, made long enough for the thickest flange (20-inch extra heavy), was made to go with these patterns. When used for the thinner flanges, they were stopped-off by a plug of necessary length.

In fixing the length of the smaller sizes of these boxes another deficiency in the completeness of the patterns was discovered.

The length was found by placing the hubs central on the 20-inch heavy flange and then taking the distance from the end of the coreprint on the hub to the surface of the recess in the flange with calipers. This was the length of box necessary for the size indicated by the hub used.

When the 5-inch hub was so placed, the 3/16 dowel didn't fill the ¼-inch central hole. As already stated, the original plan had contemplated but one size of dowels, ¼-inch. If the necessity of securing the parts together to prevent errors in locating the hub for successive castings had been foreseen, a smaller dowel would have sufficed to center the hubs, and all might have been of the same, smaller size.

The trouble was overcome by making a second set of hubs, from 5-inch down, with ¼-inch dowels.

This set of patterns is only intended for flange orders when the number of castings of any one kind is too small to make a special pattern profitable. The fact that they were made with dry-sand cores added a little to the cost of each casting, but the appearance of the finished flanges compensated in a measure for this, and when the order was such that the cost of the cores would nearly or quite pay for the special pattern, it was made at once.

It is not necessary to have coreprints for both ends of such cores as would be made for these castings, as the diameter is usually much greater than the length, and the cores would stand on the flat end without any tendency to tip over.

The hub side of the flange should be in the nowel; in fact the whole pattern may be in the nowel if the hub is so placed. This will make the setting of the core very easy, and even if the core is a little short and does not fit the print *too* snug, the tendency to float when the mold is poured would cause it to bear hard against the cope, thus preventing the hole from "capping over."

A good process of enameling iron goods an ivory color is given by the *Scientific American* as follows: Melt a mixture of 125 parts of pulverized flint glass, 20 parts of calcined soda and 12 parts of boracic acid. The molten mass is poured onto a stone or metal surface, allowed to cool and pulverized. A mixture of this powder and soda water-glass solution of 50 degrees Beaume, to which about eight parts of oxide of tin have been added, is poured over the objects to be enameled, which are then heated in a muffle until the entire mass is uniformly melted.

Methods of Cleaning Work for Electro-plating

The cleaning of metal work before plating is quite a serious proposition as unless this is done thoroughly the plating is unsatisfactory and not durable. While most cleaning methods depend on dipping in hot solutions to dissolve the grease, many have experimented with an electric current for this purpose in a similar way to its use for plating. The principle is that the current decomposes the cleaning solution and the positive elements being freed by the electrolytic action, are carried to the work which is suspended in a wire basket from the cathode rod. The elements in this way combine with the soluble grease on the work, and saponify it. A quantity of hydrogen globules are produced at the surface of the work which have power enough to throw off such insoluble particles as emery, tripoli, etc., and leave the work chemically clean.

The reason this has not come more largely into use is that the cleaning liquids have attacked the metal as well as the grease and this has prevented the use of such a system in many cases.

At a recent visit to the shops of the Frank Mossberg Company, Attleboro, Mass., the writer saw such a system in use which was giving excellent results and apparently without any injury to the metal to be plated. The work, just as it came from the shop, was put into iron wire baskets and hung from the cathode rod into the solution which was kept hot by a steam pipe running through it, the heat making the cleaning action much more rapid.

The tank is of iron, making the anode pole with plenty of conducting surface and while with this construction a minute quantity of iron enters the solution it is not enough to do any harm. The cathode rod is insulated by wooden blocks and the baskets of work hung from this into the solution. From 2 to 4 volts are required according to the resistance of connections, the solution itself taking 1.4 volts. The amperage will run from 40 to 80. The action of the bath is very rapid and can be seen by the chemical agitation of the bath as the grease is "boiled" off and very dirty work is cleaned in from one to two minutes. As the plating takes from twenty to sixty minutes it will be seen that a small cleaning tank will care for a large plating room. The after treatment is much the same as with any cleaning, a sawdust bath and a dilute acid dip for iron or a weak cyanide dip for brass being used to remove the slight oxide which forms even while being carried to the plating room. The cleaning solution used is known as the Electric Cleaning Compound and is made by the Cleveland Platers Supply Company, Cleveland, Ohio.

General Instructions for Machine-shop Methods

The Following of Which Develops Connected Reports and Records of Material, Labor and Product and Promotes Efficiency

BY HOLDEN A. EVANS*

In describing the system of shop management followed in the shops under my supervision little claim is made to originality. It has been my aim to introduce efficient, modern shop methods, and the best practices of modern commercial shops have been copied as far as possible. The system used and the methods followed were not devised or obtained in a few weeks or months, but are the result of three years of hard work. I have no doubt but that the methods followed will be adversely criticized by some for having too much "red tape," and for increasing the number of "non-producers." The criticisms should, however, be applied to the *description* of the methods and not to the *methods* themselves. An examination of the system in actual operation shows that it is very simple and effective, and that no unnecessary non-producers are employed. Furthermore, the cost returns tell whether a system is a success or a failure, and in this case these returns show a large reduction in the cost of the shop work.

The system in use is based primarily on the teachings of Mr. Taylor on shop management. His "functional management" is accepted outright, and the duties of "speed boss," "gang boss," etc., are the same as described by Mr. Taylor except for minor modifications. His method of observing unit times is also adopted. There are, however, two important differences between this system used and Mr. Taylor's. His system is primarily for piece work, or some form of bonus work, while the system described is for "day work."

Mr. Taylor's system contemplates instruction cards to each workman telling him in the greatest detail how each operation is to be performed. In this system the instruction cards only tell the workman what is to be accomplished and he, with the assistance of the speed boss, determines the detail methods. There are two important reasons for this variation, the more important of which is the fact that the navy-yard shop is a jobbing shop and the work is varied. It is frequently necessary to send the shop men with the outside force to work on the ships under repairs where it is impossible to give men detail instructions, and where there can be but comparatively little supervision. Thus each man must, to a great extent, determine for himself the best methods to be followed in doing the work. Any system which dwarfs the natural ingenuity of the workman, or which takes from him his self-reliance, would eventually cripple a navy-yard shop. The workman must be educated to think for himself, so that when taken from the shop to the ships for rush-repair work he can carry a job to successful completion without having a foreman standing over him telling him every step he is to take.

Even in times of peace it is of frequent occurrence to have 12 to 15 ships scattered along a half-mile of water-front. Of these frequently half may come in at one time for repairs. In this case it is necessary to use many of the shop men on the outside work and fill their places in the shop with new men; as the abilities of the new men are not known, they must have necessarily close supervision, which can only be given in the shop. With men scattered all over these ships, from the steering engine, aft under the protective deck, to the anchor windlass forward on the forecastle deck, it is out of the question for the outside foremen to give the men detailed instructions. After laying out the work in a general way the outside supervisory force must give considerable attention to ordering the necessary repair parts and material so that the outside force will not be delayed by lack of these essentials; thus only general supervision can be given to the work itself. Furthermore, possible war conditions must be considered. In the event of war, or threatened war, the force employed would be greatly increased, and the old men who are accustomed to warship repair work must be depended on as the nucleus to break in the new men employed. For these reasons it is considered wise not to give the shop men minute instructions for each operation; it is believed that men capable of carrying their own jobs are not developed in this way.

Again, the labor involved in preparing detail instructions where the work varies greatly is large, and in a government shop

DAMAGE REPORT

CONSTRUCTION AND REPAIR

NAVY YARD, MARE ISLAND

Date: 12-16-07

Name: Smith Rate: 3 a 8

I have damaged the following work under Job Order No. 3276-2.M57.

Owing to carelessness in setting tool I drove into bolt and left no stock for thread on three bolts

Report of man in charge of work:

I find that man did not have tool right ahead and it drifted sufficiently to remove necessary stock for thread

Jones - Speed Boss

Report of master:

This man was properly instructed how to do the work and had the standard drawing to guide him

Estimate to replace damage:

J. Doe

Labor 2.00

Mat'l 2.64

Action of Naval Constructor:

Replace - Warn Smith and record in book

FIG. 1. A SPECIMEN DAMAGE REPORT

*Naval constructor, United States Navy, Mare Island, California.

it would be difficult to obtain the necessary competent force to do this work.

As previously stated, "day work" is at present the result of circumstances over which I have no control. It is believed, however, that there is a great advantage in getting a shop up to its maximum efficiency as a "day-work" shop before going to premium work. In this way the standard times can be set with much greater accuracy. There should then be no need or no desire to cut these times unless radical changes are made in the methods on account of improvement in the shop equipments. It has been my aim to obtain the maximum efficiency under the day-work plan, and at the same time to obtain data that will make it easy to go to the premium plan whenever circumstances will permit. The system under which the shop is operated secures both of these results.

There are a number of general instructions which apply to all of the shops under the one management as these have to do with the management of the machine shop the most important will be given first.

General Instructions Applying to all Shops

Delivery System between the Offices

(a) Store orders, shop orders, leave cards, quit-work cards and reports are, in the majority of the navy yards, sent from office to office or to the main office by a helper or laborer attached to each shop. This method of handling these papers is expensive and unsatisfactory. The ideal method so far as operation is concerned would be to have pneumatic tubes connecting all the departments. In nearly all yards, however, the shops are rather widely distributed and the installation of pneumatic tubes would involve a large expenditure of money which would not be warranted by the results obtained. In the department under my supervision the following simple arrangement has been found satisfactory:

In the main office there is a set of post-office pigeon holes; one for each foreman or shop; one for each officer attached to the department, and one for each sub-department in the main office, such as drafting room, requisition office, etc. In each of these offices there are two mail baskets, one "out-going," the other "receiving." A boy distributes all papers from the main office to the foremen's offices and all papers between the foremen's offices. He starts his first trip at eight o'clock in the morning taking all papers from the pigeon holes and putting each shop's papers in a separate envelop. These papers are distributed to the various shops, being placed in the receiving basket. All "out-going" papers are collected and returned to the main office where they are distributed for the next trip which begins at nine. This is continued throughout the day; a round trip is made every hour.

Soon after this system was first started it was found that the boy was irregular in the collections. This was corrected by having him carry a small watchman's clock having a key at each point of collection. The dials from the clocks are examined each day by the chief clerk. The papers for the various officers and sub-departments in the main office are distributed from the "post office" by the office messenger.

Damage Reports

(b) The following is an extract from instructions which are issued: "1. Whenever work is spoiled or damaged, no matter what the cause, a report will be made by the man spoiling the work, this report is to be made on a 'Damage-Report' blank. This will be indorsed by the leading man or other employee in charge of the work. The foreman will investigate and make recommendation; he will also make an estimate of the cost to replace the spoiled work or to correct the damaged work. The report will be forwarded to the naval constructor for his action. After being signed by the naval constructor the necessary action will be taken by the foreman as ordered by the constructor.

"2. Whenever a machine or appliance is damaged the same procedure will be followed and a 'Damage Report' submitted.

"3. Damage reports for work under job orders will be attached to the foreman's copy of the job order and will be turned into the main office when the job order is closed, with the actual cost of the work to correct the damage written on the face of the damage report opposite the estimated cost. If there is material difference between the *actual* cost and the *estimated* cost, the chief clerk will call the naval constructor's attention to the report. The damage reports will be filed with the cost cards in the chief clerk's office.

"4. Damage reports for tools or appliances, after the damage is corrected and the actual cost entered, will be forwarded to the chief clerk. If there is material difference between *actual* cost and *estimated* cost, the chief clerk will place the report before the naval constructor. These reports will be placed on a file for damages to machines and appliances."

The form used for this report is self-explanatory, and a sample report on this form is given in Fig. 1.

Records of Workmen

(c) In each shop the foreman is required to keep a record of the mistakes, neglect and minor offenses of the men under him. The use of damage reports as previously described will bring out the necessity for such a record. A man through carelessness makes an error in machining a piece of work which involves only a small loss; it is out of the question to suspend or discharge him for this error, for this may be the only error he has made in six months. Moreover, severe penalties for errors of this kind will make workmen over-careful; they will take an unnecessarily long time on their work and run up the cost. On the other hand, you want to find the man who habitually makes mistakes and the written record brings this out. The action on damage reports of this kind is for the foreman to warn the man and record it in the book. When a man stays out a day or half-day without getting permission, and does not offer a satisfactory explanation, this is also recorded. In other words, all offenses that do not warrant suspension should be recorded. All suspensions are also recorded in the book, in addition to the record in the main office. The knowledge among the men that such books are kept has a good effect. Besides, when a reduction of the force is necessary it enables the foreman to instantly pick out the careless men. This is not the case if memory alone is relied upon. It also enables the head of department to hold the foremen to an accountability for recommendations for discharge. The books are called in every three to six months to be inspected by the head of department.

Methods Followed in Issuing and Correcting Plans

(d) The following is an extract from instructions which are issued:

"When estimates are being prepared the officer having charge of the work will add to all items for which he considers a plan necessary, the following clause:

'As per plan No.....'

"When estimates are submitted including such items the correspondence clerk will send the press copy to the chief draftsman with a slip attached marked 'Plans.' The chief draftsman will enter the number of the plan on each item requiring one, return the correspondence for file, and then proceed with the preparation of the plans, consulting the officer in charge of the work.

"When the work is authorized the correspondence will be sent direct to the chief clerk who will prepare the job orders and send those requiring plans to the chief draftsman, who will note on the face of the job order the names of the foremen to whom plans have been or will be sent, and the date that such plans were sent or when they will be ready for sending. He will also make a record on suitable cards of the plans required, and when required, job orders, etc. The job orders will then be returned to the chief clerk who will send them along with others issued under the same authority to the officer in charge of the work, who will initial and send them to the naval constructor's desk for signature.

"When, after the issuing of job orders and plans, it appears necessary and desirable for any reason to make changes in the plans, the foreman holding the job

order will return the job order with his copy of the plan to the chief draftsman with a statement of the change he considers necessary, or at whose direction the plans are returned. The chief draftsman will then consult the officer in charge of the work as to the desirability of the changes suggested and correct the plans accordingly, noting on the face of the job order and also on the plan the date of the correction. Copies of the plans held by other foremen will be corrected at the same time.

"In order to insure that work will be done according to the plans issued and also to insure the correctness of plans, foremen will be careful immediately upon the receipt of plans to scrutinize them carefully and point out to the chief draftsman any changes which they may consider desirable and return the job order together with the plan as indicated above. In cases where the work is already being proceeded with before the desirability of a change is discovered, the quarterman or leading man in charge of the work will immediately take the matter up with his foreman and chief draftsman so that the change, if desirable, may be made at the earliest possible time. It is expected that foremen, quartermen, and others will take every opportunity to make suggestions whereby the simplification or the betterment of plans may be effected."

Shop Orders from One Foreman to Another for Work Already Ordered

(e) Extract from instructions issued:

"Shop orders will be made on blanks as given in Fig. 2, and the following instructions will be followed:

"The shop-order number, date, job-order number, title, appropriation, and, where there are plans, plan number will be in all cases filled in.

"The foremen to whom the shop order is sent will be indicated in the upper left-hand corner on the shop order and stub and the foreman by whom sent in the lower right-hand corner. The stub will not be signed.

"On the face of the shop order the instructions covering the work required should be written out in as much detail as practicable. Where the work is required to be completed by a certain date this will be indicated in the lower left-hand corner on the line marked 'Work desired completed by.....'

"The above information will be filled out in all cases. Where a promise of the date of completion is desired, the foreman issuing the shop order will fill in the first line by the printed form of the stub. Where no promise is desired this line will be left blank. Where work is of such a nature that its completion is of no special importance a promise will not be required.

"Upon receipt of shop order requiring a promise the second and third lines of the stub will be filled in without delay and returned to the foreman issuing, or forwarded to the foreman whose work will be required before the completion of the shop order. This latter will be required only in case of shop orders issued to the patternmaker for castings. On the second line will be placed the date by which the work is promised, and on the third line the foreman to whom forwarded will be indicated as well as the date of forwarding. On the fourth line the date on which the work involved in the second operation is promised will be placed, having taken into consideration the time of the first promise. The date of returning promise will be placed on the fifth line and the stub returned to foreman originally issuing.

"If the date of promise is satisfactory, the stub will be reissued by the foreman holding the job order and the date of reissuing filled in. The stub will then be held by the foreman on whom the shop order was issued until the work has been completed when line 7 will be filled in and the work and stub together forwarded to the foreman making the second promise.

"The date of the completion of the second part of the work will be filled in on line 8 and the shop order forwarded with the work to the foreman holding the job order. Upon checking this over and finding the work satisfactory, the date of this inspection will be put on the ninth line by the foreman inspecting, or his representative, and the stub will then be returned to the foreman on whom the original shop order was issued, and will form his receipt for the satisfactory completion of the work.

"In cases where a promise of date of completion is required, the starting of the work will not be delayed until the return of the stub, but will be commenced as soon after the receipt of the shop order as practicable.

"Should the date of promise be unsatisfactory, or the work as received unsatisfactory, a brief statement of this will be made under 'Remarks,' and the stub returned for reconsideration of promise, or for correction of the work by the foreman under whom the work is to be, or has to be, done.

"All shop orders as above outlined will be written with indelible pencil and a carbon copy made. The original of the shop order will at all times remain in the custody of the foreman on whom it was issued and the stub of the original will pass between foremen. The carbon copy of the shop order will be filed with the job orders by the foreman issuing, all shop orders under one job-order number to be filed together. Upon the completion of the job order all shop orders issued on it will be taken from the file and kept a sufficient length of time for reference. The stub of the carbon will be used for convenient reference for checking dates

Stub Reg. No. 6576 — Jan. 14, 1908

Department of Construction & Repair — *Account* E — *Title* Z

To the General Storekeeper:

Please deliver to C & R Machine shop. — *Job Order No.* 3029 Z/137

Object or General Head: South Dakota, Make chests.

Appropriation, Increase of the Navy — *Appropriation* Construction and Machinery

(Appropriation to be entered in case of issue of naval supply fund stock or that involving adjustment of appropriations.)

QUANTITY	ARTICLE	SPECIFICATIONS (To be filled by Issuing Officer)	UNIT PRICE	DOLLS	CTS.
2	Hasps and staples 9 - ½";				
	boat chest 03307.				
2	Pad-locks 2-¼" with chain.				
1	gro. F. H. B. wood screws ⅞"	# 12.			
1	" " " " 1 - ½"	" 12.			
2	pr. Butts, 4"x 3 - ½", f. j. b.				
3	lbs. Galvd., cut nails 6d tinished.				

Respectfully, J. Smith

Naval Constructor U.S.N. *U.S.N.*

Received the above-named articles

J. Brown

Master Machinist

FIG. 2. A SPECIMEN MATERIAL REQUISITION

of promise by means of tickler or other system. Where the promise was not originally required, but later was found to be necessary, the stub of the carbon will have the date on the first line filled in and will then be forwarded to the foreman on whom the shop order was issued and will follow the course described above for the original stub.

"As at present, shop orders on standing job-order numbers will, before being forwarded to the foreman, be sent to the naval constructor to be initialed."

Material Supply

(f) In navy yards, all material, except heavy structural material, is kept in the general storehouses under the charge of the storekeeper, who is an officer of the pay corps of the navy. Owing to the governmental methods of purchase, that is, advertising and inviting the widest competition, it requires some time to obtain material. For this reason, and further, that all the material required aboard ships in commission is obtained from the navy yards, large stocks of material must be carried. Furthermore, by purchasing material in large quantities the lowest prices are obtained. The material is obtained as needed by the manufacturing departments by making requisitions on the storekeeper. These requisitions are made out in duplicate by means of a carbon by the clerk in the foreman's office, or, in the case of the machine shop, in the planing department, on blanks as shown in Fig. 2. These are sent to the main office by the messenger service previously described for the signature of the officer in charge of the work, and are then sent to the storehouse at 9:15 a.m. and 1:15 p.m. The material as called for by the requisitions is immediately collected at the storehouse, and at 10:30 a.m. and 2:30 p.m. the material man with a team calls for the material, checks it off, and delivers it to the various shops of the department, consisting of shop-fitters shop, foundry, machine shop, smith shop, joiner shop, boat shop, plumbing and coppersmith shop, pattern shop, electric shop, paint shop, spar, cooper, and block shop, sawmill, and shipwright shop. Heavy articles are loaded on small railroad cars and hauled to the shop. The material man is responsible for all deliveries.

After the articles are delivered the storekeeper prices the requisitions and returns the copy to the head of the department obtaining the material, and retains the other as a voucher for the issue. The cost of the material is charged against the job in a lump sum, and the returned copies of the requisitions are filed with the job-order cards, so that at any time an exact statement of the material used on a job can be readily obtained.

Work, Reports, or Requisitions Requiring Immediate Action

(g) A "pink urgent slip" is used to attach to orders for work, requisitions, or other papers when the occasion necessitates immediate action. Anyone receiving orders or papers with one of these slips attached is required to give the subject immediate attention and give all such work right of way over ordinary work. Anyone using these pink slips must sign them, and he is held strictly to account that the work is *really* urgent, for it is realized that if this is not done and the slips are used for work that is not urgent the object of the slips will be defeated.

Weekly Meetings of Head of Department and Foremen

(h) The head of the department has a conference with the 14 foremen of the department every Monday afternoon at 2 p.m. This usually lasts nearly the whole afternoon. Nothing is allowed to interfere with this meeting. At this conference the work in progress, proposed improvements and the policies of the department are fully discussed. The procedure is as follows:

(1) *The Work in Progress*—Under this head is discussed the time of completion desired on the various work under way, whether more men should be taken on or drawn from work that can wait, why the progress on certain work is slow, what difficulties are encountered, etc.; in other words, a full discussion of current work. It is my experience that, when foremen are taken to task for delays, it is always the "other fellow"; he couldn't get his work out of the smith shop, or the foundry; or the machine shop did not do the work properly; or the laborer did not get the crane or furnish transportation in time; or some other excuse of this kind. When these subjects are taken up in the presence of all the foremen the excuse of the "other fellow" is not so frequent. If it is the "other fellow" who is to blame it is freely brought out in a free discussion of this kind. At this meeting the head of the department settles all of these differences and lays out the immediate work as he wishes it done. Every foreman fully understands his wishes and directions, and has no excuse if he does not work with the others to the desired end.

(2) *Suggestions from the Foremen*—After the current-work discussion each foreman is asked in turn for suggestions as to improvements, either of facilities or methods. Every suggestion is fully discussed, even though the suggestion may at once appear to the head of the department as valueless, and all foremen are invited to advance their ideas on the subject though it may not affect their departments. Some suggestions are adopted at once and a note is made of them; others are rejected; some require farther investigation, a note being made of these also.

(3) *Suggestions from the Department Head*—After all suggestions from the foremen have been discussed, the head of the department takes up his suggestions. It is my practice to make notes during the week of the subjects which I wish to bring up at the next conference. In addition to the discussion of current work and general improvements in appliances or methods it is my practice at these conferences to point out the weaknesses of the various shops—not only those discovered in my usual rounds of inspection, but it is my practice to take each shop in turn week by week and make a diligent hunt for the uneconomical methods. At the next meeting these are all brought out and frequently samples of the work illustrating the uneconomical methods are exhibited.

There are some who will question the advisability of bringing up these weaknesses in this manner at the general meeting, and will say that the same results could have been obtained by calling the foreman of the shop and going over these subjects with him alone, and that a foreman resents a public demonstration of this kind.

I use a public demonstration of this kind as an object lesson to all. I want each foreman to know that I am *hunting* for all uneconomical methods. I demand that they do the same. I want each foreman to think for himself "how can I save money on this job." No doubt the foreman does resent the public demonstration, but he will try to see that there are no more public demonstrations of his shop. The next week he will perhaps enjoy a public demonstration of one of the other foremen.

After the meeting is over a stenographer is called and the necessary instructions are given on all matters settled and a record on cards is made of all unfinished work; these cards are brought up at subsequent meetings.

I attach great importance to these conferences and am satisfied that much progress is made by means of them.

A following article will treat of some of the details of the navy-yard machine-shop methods.

A certain nickel-steel alloy called Invar, having a small coefficient of expansion, was produced by Dr. Guillaume, of the International Bureau of Weights and Measures, some few years ago. It was at once proposed to use the alloy for accurate base measurement, owing to the great reduction of temperature errors. The manufacture is carried on near Paris, a secret process being employed. Experience with tapes of this metal for the measurement of primary bases has been gained by O. B. French, who gave the result of his experience in a paper before the American Society of Civil Engineers. The first advantage of invar tapes over steel is that measurements may be made in daylight instead of at night, as is necessary with steel tapes. Speed and accuracy are thereby increased and the cost is at the same time diminished.—*Indian Engineering.*

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Reamers for Choke Boring Shot Gun Barrels

It occurs to me that the readers of the AMERICAN MACHINIST may be interested In this subject, as the choke boring of shot-gun barrels is more or less of a mystery to most people.

After talking with several of his expert barrel men, the superintendent of a well-known gun factory conceived the notion that it was time to investigate the process and see what could be done in the way of clearing up some of the mystery and improving the method of doing the work.

It fell to my lot to look into the old methods and talk with some of the specialists in that kind of work and finally to lay out and have made and tried out a set of reamers for this work, which it is the purpose of this article to describe.

I found them using two different tools, the first of which was the old-fashioned square reamer, which is nothing more or less than a piece of square steel of suitable length with two corners ground to a sharp edge. It is inserted into the barrel and then backed up with long hardwood strips. The barrel is held from rotating in a suitable fixture. Plenty of oil is applied and the reamer is rotated by power, slowly. This crude tool in the hands of a man who has been doing this kind of work for twenty years, more or less, will turn out work that is truly wonderful, and the pride that some of the men take in the work is equally wonderful.

One man, who had been for many years at it, told me solemnly, on several different occasions, that he could bore a barrel that would shoot any kind of a pattern I wanted with one of these tools, and the only test he required was to hold the barrel up to the light and cast his eye through it. Further than this, he assured me that he could make two barrels so near alike that I would not be able to find 0.0001 inch difference between their bores, even if I tested them with a "cyclometer." I don't suppose that man had any more idea of what 0.0001 inch meant than he had of the proper name for a micrometer; but he certainly did know how to bore barrels, and more than that, he had an idea that tools could be made that would bore them just as well and much quicker than he was doing it. His reason for thinking so was that he had some reamers with left-hand spiral flutes, that he and his fellow workmen used to "lift" the most of the stock out of the barrels before using the square reamers. The process was slow, even with them, for the reamers had to be backed out several times to clear the chips from the flutes, when using the fluted reamers, and when using the square reamers the cuttings had to be cleaned out and the bore inspected frequently to see if it was coming right. The fluted reamers he was sure he introduced into the factory a number of years before, at any rate they were there and had been for years. From all I could learn the first of their kind were brought there years ago by another man who is still there using them.

A shot-gun barrel that is bored with a full choke is simply a tube with a straight smooth hole through it, but the hole at the muzzle is about 0.030 inch less in diameter than the rest of the barrel. The change from the large to the small diameter is in most cases effected within 2½ inches of length. The rest of the bore is perfectly straight. This is sometimes accomplished by swaging the muzzle end down after boring a hole the same diameter all the way through, but in all the best guns it is accomplished by first boring a hole straight through the required muzzle diameter and then enlarging the bore from the breech up to the choke. The exact shape of the choke that will give the best results is a question that is not yet settled so far as I know, but the reamers here described were made plain taper at the front end and barrels reamed with them gave good results when it came to the shooting test.

Fig. 1 is a section taken through a portion of the barrel with the finish reamer *A* in the position it would be when the reaming is finshed. *B* is a piece of drawn-steel tubing about 40 inches long and secured to *A* by sweating with soft solder. *D* is a hole drilled into the shank of *A* deep enough to allow the long narrow opening *E* to be made crosswise through the shank. This opening is made long and narrow so as to get an opening with an area equal to the area of *D* with the least possible weakening of the reamer shank. The shank diameter at *F* was made about 0.005 inch less than the diameter of the back end of the reamer.

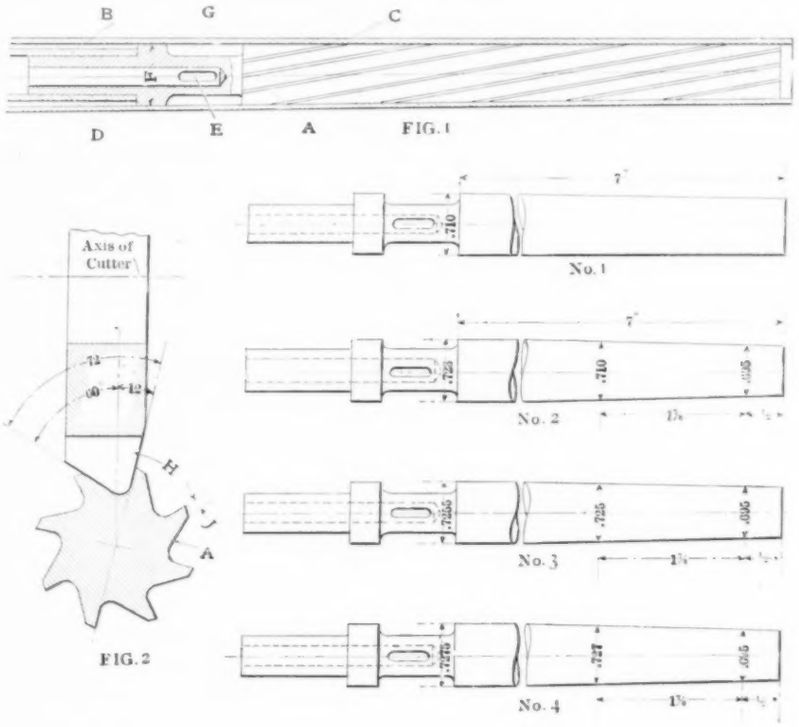


FIG. 3

REAMERS FOR CHOKE BORE SHOT-GUN BARRELS

Fig. 2 is an enlarged section taken perpendicular to the axis of the reamer, showing the shape of milling cutter *H* used to flute the reamers. The dimension

I was about 0.035 inch. The reamers were fluted with eight flutes to cut right-handed, but the flutes were cut left-hand spiral, one turn in 13.33 inches.

There was a barrel-reaming machine available that could be made suitable to try these reamers out with, by making some changes in the feed mechanism, which we did. To understand the working of the reamers it will be necessary for me to say that this machine was equipped with a gear pump that was capable of giving an oil pressure of 200 pounds to the square inch. The oil was piped in such manner that it could be fed through the spindle, tube *B* and openings *D* and *E* out into the chamber *G*, which was formed between the reamer shank and the inside of the barrel. The reamer rotated with the spindle while the barrel was held in a sutable fixture and was fed on to the reamer. A short tube was used to cover the reamer when starting into the barrel. The shank was so large at *F* that only a small portion of the oil could get past it. The result was that it flowed down the flutes with sufficient force to keep them perfectly clear.

The reamers were used one after another as they are numbered in Fig. 3, and No. 2 reamer removed 0.013 inch of stock. This it did at 112 revolutions per minute and a feed of 0.038 inch per turn, thus reaming the length of a 30-inch barrel in seven minutes. It did it without the slightest trouble and I am quite sure it could be done much quicker. Just how much I do not know, as it was up to me to get them to work at reasonable speed and do good work. More speed could be developed later. The holes these tools produced were perfect so far as I could see and they were so pronounced by my expert barrel friend.

E. N. Amory.

Bridgeport, Conn.

A Screw-cutting Job

The accompanying sketch gives particulars of a job of thread cutting and illustrates the manner in which it was done. I had an old English lathe, the lead being two threads per inch.

In Fig. 1, *A* and *B* represent the screw and nut respectively. The thread to be cut was a quadruple one, 2-inch pitch, right hand. After considering the large pitch I thought it preferable to drive from the lead screw, which called for some arrangement or other that I had to make in my own time, as the job was piece work. As shown in the sketch, both screw and nut had shoulders standing in the way of the threading tool when it is running out of the cut; so I abandoned the power drive in favor of the handle, which when all the castings were ready for threading, I fixed to the end of the lead screw.

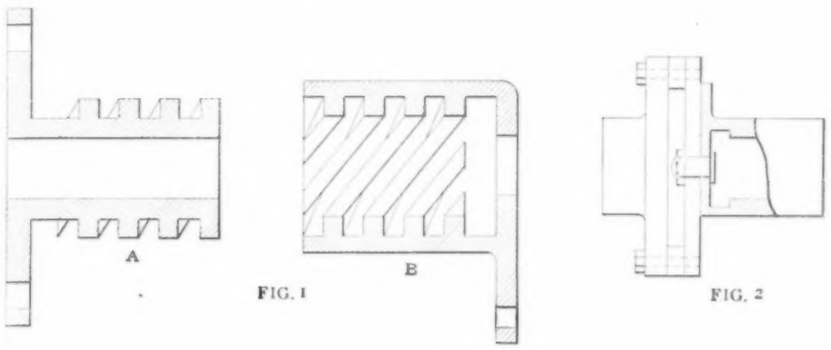


FIG. 1

FIG. 2

THE WORK TO BE THREADED

After doing a couple of screws I found it awkward to manipulate the driving and cross-feed handles, on account of their being too far apart; as a laborer was not available, I had to bring the driving mechanism nearer to the carriage, which I did in the simple way here shown. The scrap heap supplied the few necessaries consisting of a bar of flat steel *A*, Fig. 3, to which was secured bracket *B* carrying shaft *c* and bevel gear *d*. Bevel gear *e* was slid on the lead screw. Bar *A* as mounted, was then placed across the lathe bed as close to the carriage as the travel of the latter would allow, the two bevel gears put in mesh and nut *g* and screw *s* tightened. To effect the division into four, I opened the split nut, moved the carriage along over one thread of the lead screw and closed the nut down. Fig. 2 shows how the nut was held for the screwing operation.

The job required a little elbow grease, but the money figured out satisfactorily.

London, England. H. Egloff.

Chucking Warped Gears

Gears which run at high speeds should be carefully mounted. This is difficult to do when one takes into consideration the slight deformations due to warping in hardening. The most satisfactory way is to chuck the gears by the teeth at the pitch circle and grind the shaft holes. The various methods we have heretofore used have been adaptations of the "universal" mandrel, but as these have not given satisfaction we were compelled to devise a method based upon an entirely different principle. This chuck consists of a face plate *B* Fig. 1, fitted to the nose of the lathe spindle *A* and seated on the cone *I*. This face plate carries inside its flange a steel ring *C* which is hardened, ground and forced into place. The inside of the ring is slightly tapered. The toothed wheel *D* enters the ring *C* with a certain amount of play and rests upon the plate *B*. The gear *D* is centered by means of the tapered pins *G*. These pins *G* are of tempered tool steel and are tapered slightly less than the taper of the ring *C*. When they are placed between the teeth of the gear it is centered by its pitch cir-

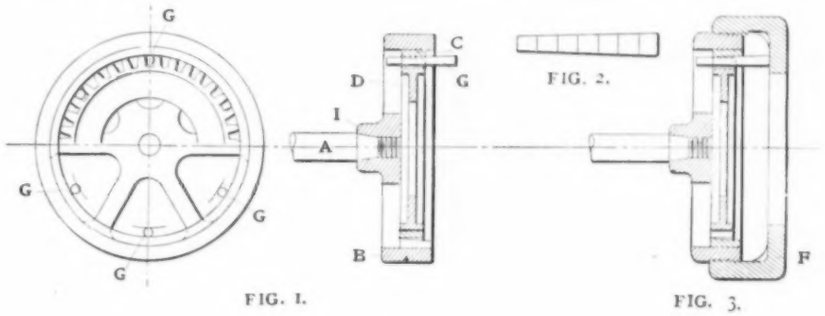


FIG. 1. FIG. 2. FIG. 3.

CHUCKING WARPED GEARS

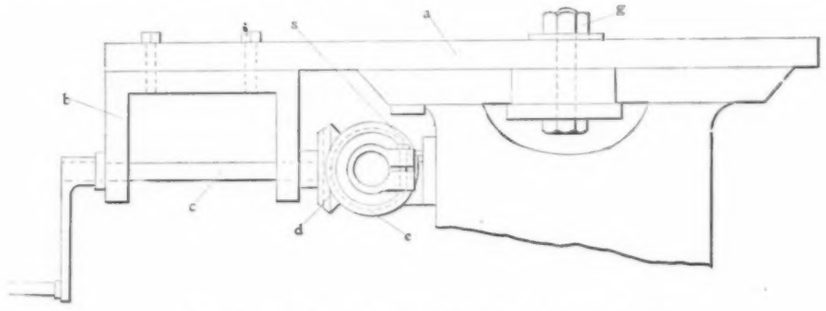


FIG. 3. DRIVING THE LATHE FROM THE LEAD SCREW

cle. By using the cap F shown in Fig. 3, which screws on the flange of the face plate, the pins are forced in equally.

This device can be used for a number of sizes of gears by substituting various sized rings C.

Paris, France. STE' A. A. E. P. L.

Drawing Board for Detail Work

The design of commercial motor cars calls for a large drawing board. It is advisable to develop three views at the same time. Various things, such as the movement of the springs under load, with the consequent effect on control connections, render it advisable to have all views in a position to scale and plot movements readily.

On account of the large number of details to be worked in, the sheet holding the plan and side elevation is apt to become much soiled. When the sheet is only large enough to accomodate two views, the front elevation is commonly put on a second.

In developing this from the first two, the class of table shown in the sketch has been tried and found very convenient, the dimensions and general style shown being for detail work only.

The spring shade roller carries a cloth which may be brought up over the board at night or when leaning on the table. A rack is shown at the back of the table which carries the drawing that is being referred to.

It is far superior to a reference table, as it is continually before the eye, and it is not necessary to turn from the work to consult it. By pulling the drawing, the rack swings toward the draftsman, being returned to its upright position by means of the springs. The familiar "Bull Dog" clip holds the drawing fast to the rack.

Detroit, Mich. ROBT. G. PILKINGTON.

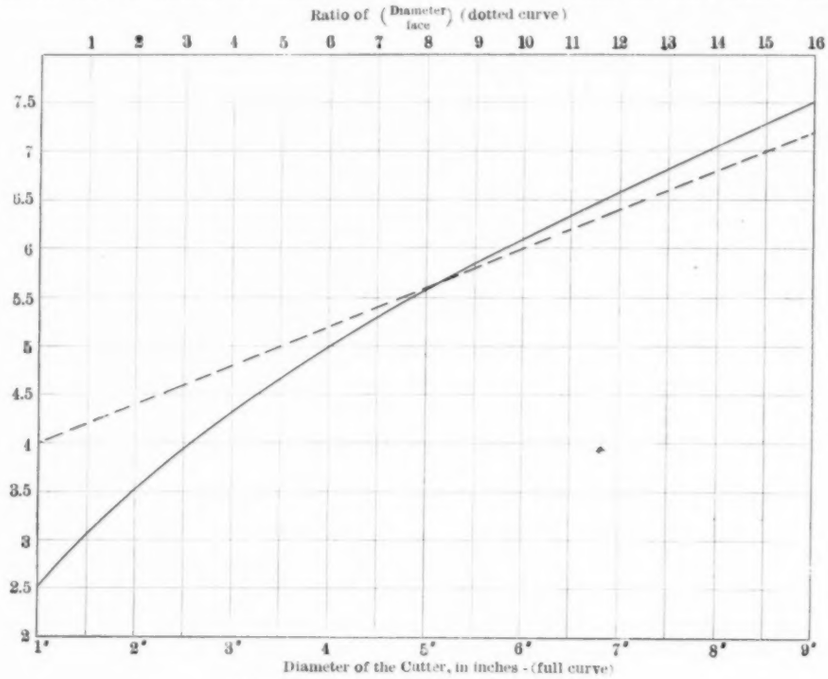
Number of Teeth in Milling Cutters

There seems to be no definitely stated rule for the number of teeth for ordinary plain or spirally grooved milling cutters. About 1890 the rule

$$17.7\sqrt{Diameter} = Number\ of\ teeth$$

was given by Mr. Addy; but however suitable this may have been for that period, it is a long way out at the present time. Cutters are now made of much coarser pitch and take much greater depths of cut. This has been found to give better results when the machines are powerful enough in drive and feed. The correct way to decide the number of teeth would be, of course, to consider each case separately and select the number to suit. This is obviously impracticable where the cutters are to be used in general work on any and every job, material, or machine to which they can be adapted.

With a view to arriving at some simple rule for the number of teeth in such cutters, many cutters of various diameters, widths of face and numbers of teeth which had been found successful in general work were put on record. From the data thus obtained curves were plotted showing the relation of the variables. It was found that the number of teeth was not in strict proportion to the $\sqrt{diameter}$. In general the thinner the cutter in relation to its diameter the more teeth it had.


Ratio of (Diameter / face) (dotted curve)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
7.5 7 6.5 6 5.5 5 4.5 4 3.5 3 2.5 2
1' 2' 3' 4 5' 6' 7' 8' 9'
Diameter of the Cutter, in inches - (full curve)

NUMBER OF TEETH IN MILLING CUTTERS

The trend of the curves seemed to suggest a rule of the same form as Addy's except that, instead of having the constant 17.7, a variable quantity should be introduced which became greater as the ratio

$$\frac{Diameter}{Face}$$

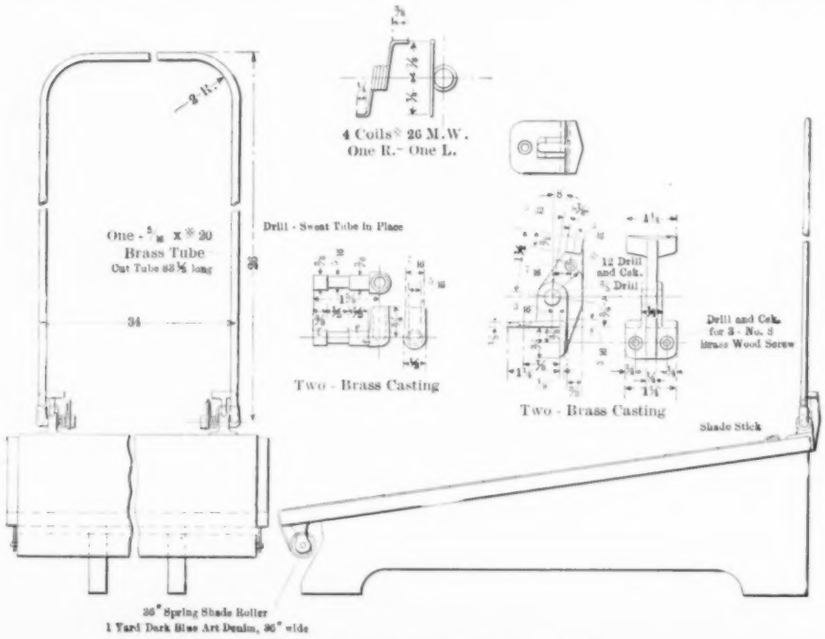
was increased. It was also determined that the values of this quantity should be much less than 17.7.

The expression which seemed to give the nearest mean curves to the observed data was,

$$N = \left\{\frac{D}{2F} + 10\right\}\sqrt{D},$$

where N = the number of teeth,
D = the diameter of the cutter in inches
and F = the face of the cutter in inches.

This formula seems to be fairly representative of good practice between $D = 1$


4 Coils 26 M.W.
One R. - One L.
One - 5/16 x 5/8 x 20
Brass Tube
Cut Tube 68 1/2 long
Drill - Sweat Tube in Place
Two - Brass Casting
12 Drill and Csk. 3/8 Drill
Drill and Csk. for 3 - No. 8 Brass Wood Screw
Two - Brass Casting
Shade Stick
36" Spring Shade Roller
1 Yard Dark Blue Art Denim, 36" wide

DRAWING BOARD WITH REFERENCE RACK

inch and $D = 9$ inches, and for values of

$$\frac{D}{F}$$

as high as 16. It is claimed that the formula will give the absolutely best general results, as to insure this would require a very searching theoretical investigation.

Those who have extended experience of milling in various lines will probably have ideas differing from these results, and it is hoped that they will be moved to express them.

In order to determine quickly the number of teeth by this formula, two curves are plotted in the accompanying chart. The number of teeth for any given cutter is obtained by multiplying the reading on the full curve corresponding to the diameter by the reading on the dotted curve corresponding to the ratio

$$\frac{Diameter.}{Face}$$

Rochdale, England. J. BUTTERWORTH.

Spiral Rolling of Metal

Seeing an article, on page 681, on a new method of shaping metals, I will endeavor to show a method somewhat similar but a quicker and simpler way of attaining the results mentioned. It does not need expensive die work, but requires good turning. The process is not new, but I have introduced many successful improvements, and now find a large field of application but cannot proceed; so I place the method before those who are likely to use it.

As will be seen by the sketches, two rolls are employed whose axes are parallel and geared to revolve in the same direction and at the same speed. These rolls of tool steel are turned with a spiral corresponding to the section desired to be formed, care being taken to leave at least three, but preferably more, formations as *A, B, C*, the final or finishing turn being *A*. In Fig. 1, *D D* are guide-pieces, *E* guide mouthpiece, *F* roll necks, *G* parting tools and *H* the gearing. The others may be said to be breaking-down grooves, but the longer the roll is extended the more power is needed; therefore, I have found the most successful forms to be the short articles shown at Fig. 2.

As in the swaging process, little or no scrap is formed; but a distinct advantage is that the resulting work has extraordinary strength owing to the twisting action of the rolls. It will be noticed that the finishing end *A* causes the metal to revolve somewhat more quickly than the other end, being of larger diameter, which produces a twist of the grain.

In the front of the rolls I employ suitable cutters and forming tools for special work, and have successfully made solid balls, conical bullets, beaded wire, screw blanks, pointed pins of a variety of shapes and many articles that would be impossible by any other method.

If the rolls are kept in good condition and perfectly smooth, the results will astonish the most skeptical. In a future article I will show scale drawings and all details of gearing employed. The gearing must be cut from the solid; for large machines skew gearing is best, as any vibration of the gear is transmitted to the rod of stock, causing errors and straining the rolls. I hope my sketches clearly show the method. I venture to think this the simpler way and invite criticism from anyone interested. O. CLERKENWELL.

Birmingham, England.

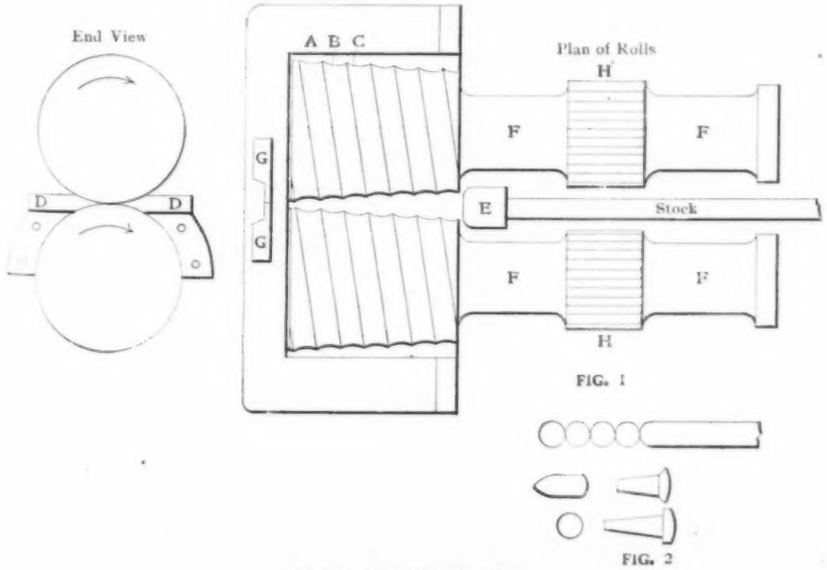


FIG. 1

FIG. 2

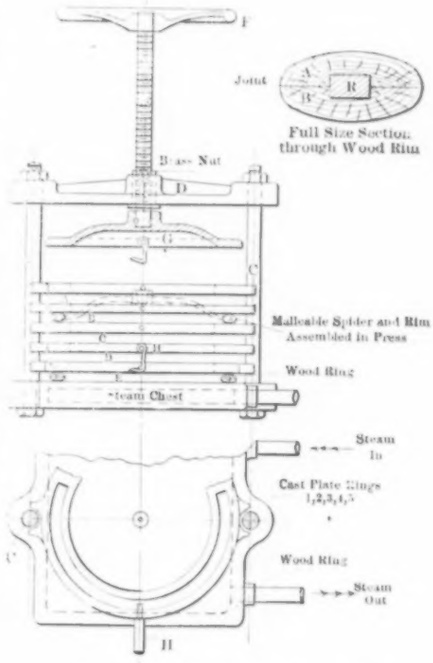
SPIRAL ROLLING OF METAL

A Press for Gluing Automobile Steering-wheel Rims

Herewith is a sketch of a gluing press made for gluing together the two half rings of an auto steering wheel, as shown in the full-section sketch. The spider or iron portion of the wheel consists of a hub, four arms and an outer ring, the latter being ⅜ inch thick by ⅝ inch wide; to it the wood rim or hand wheel is fitted, as shown in the section at *R*.

Any flaw in the material or workmanship is rejected by the inspector, consequently the gluing of the joint is no small matter. The rim is made up of two half rings *A B*, which are ½ inch thick. These half rings are made up in four segments; the recess *R* and the outside are finished before gluing them together.

The bottom plate is made hollow to allow a circulation of steam or hot water for the purpose of warming the base and



PRESS FOR GLUING STEERING WHEELS

plates 1, 2, 3, 4, 5. Pipe connections are shown at the right-hand side; *C C* are tie rods, *D* the top plate with brass nuts, *E* the screw, *F* the hand wheel and *G* the pressure plate.

The ring plates 1, 2, 3, 4, 5 form an important part of the press, owing to the disk in the arms of the wheel, which is shown by the dotted lines. At each side of plates 1, 2, 3, 4, 5 and *G* are ½-inch pins or handles *H*, from which is suspended a hook, as shown at *G* and 4 only.

The two hooks in *G* are hooked under the pins in plate 1 and support it. The hooks in plate 1 (not shown) are hooked under and support plate 2, and so on down until all are suspended by the hooks. The press is then ready for gluing, and the first rim is laid on the steam chest; then ring 5 is unhooked and placed on top of this, and so on all the way up until the press is filled. Then the plate *G* is brought down on top of the last rim, and the hand wheel *F* is used to squeeze them as tight as possible.

The glue used is a thick water-proof one and is applied boiling hot, so that

nothing short of a press of this kind will squeeze out the glue and get a perfect joint.

Milwaukee, Wis. M. E. GRAND.

Making a Bevel-gear Pattern in a Hurry

Having a rush order for a pair of match gears *A*, Fig. 2, for use on shafts *B B* at an angle of 50 degrees and having no pattern for them, I had an assistant prepare and put together a frame or stand *C*, Fig. 3, containing a swing frame *D*, while I turned up the gear-pattern blank *I*, 14 inches diameter and 2 inches face *J* and *K*, Fig. 1. Having spaced off the distances between the teeth on the inner circumferential line of the blank face *J*, Fig. 1, with a pasteboard templet, I marked the outlines of the inner ends of the teeth with a pencil to saw to. Then with the blank secured by a screw *P*, Fig. 1, to the center *T* of the swing frame *D*, Fig. 3, in a way to admit of the blank being revolved truly on its center, and with the stand *C* secured to the band-saw table in a way to bring the line of the band-saw teeth (line *R''*, Fig. 3) through the center *S* of the stand bed, also cutting the line *F* through the pins *E' E''* at *G*, I soon had the spaces between the teeth of the blank cleared away; with a little filing and sandpaper to smooth the roughness left by the saw, I had the pattern in good shape in every respect, excepting varnishing, ready for the sand, all in three hours' time.

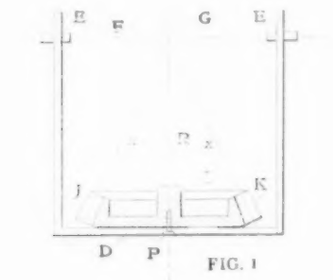


FIG. 1

FIG. 2

THE WORK AND THE FIXTURE

The points to be observed in this operation are: That the saw shall cut the axis (line *F*, Fig. 3) of the trunnions *E' E''* at right angles; that it shall cut this line at a point *G* perpendicularly over the center *S* of the stand bed; and that the center *T* of the swing bed *D* when swung forward shall pass into this perpendicular line *R'' R'*. That is, when the swing frame hangs centrally, the three center points, of the stand bed *S*, of the swing bed *T*, and of the trunnion-pin axis *G*, shall all be in the perpendicular line of the saw teeth *R''* and that the point *G* at which the saw cuts the axis line *F* of the trunnions *E' E''* shall be in the vertex of the isosceles triangle formed by the extended lateral pitch lines *X X X* at the extremities of any pitch-line diameter, Fig. 2.

By changing the location of the trunnion pins along the center lines of the swing frame, to or from the bed *D*, Fig. 3, to suit the vertex of the angle, any bevel gear may be cut which will come within the range of the length of the swing-frame arms and any diameter up to the width of the frame. Care should be used in getting the frames square and the pins in line, also in swinging the work up to the saw teeth. Needless to say, it is necessary to saw through the bed *C* to the center *S* to bring the frame or stand bed in proper position to do the cutting.

Oakwood, Mo. J. R. L.

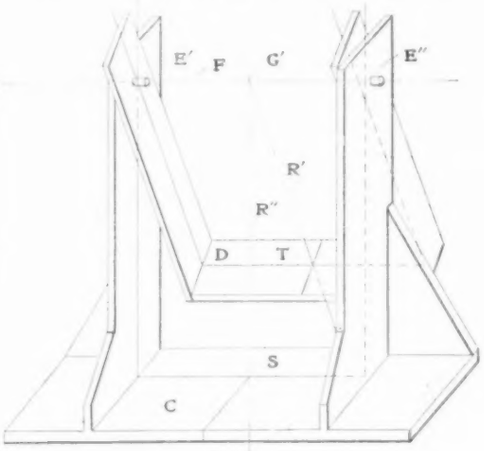


FIG. 3

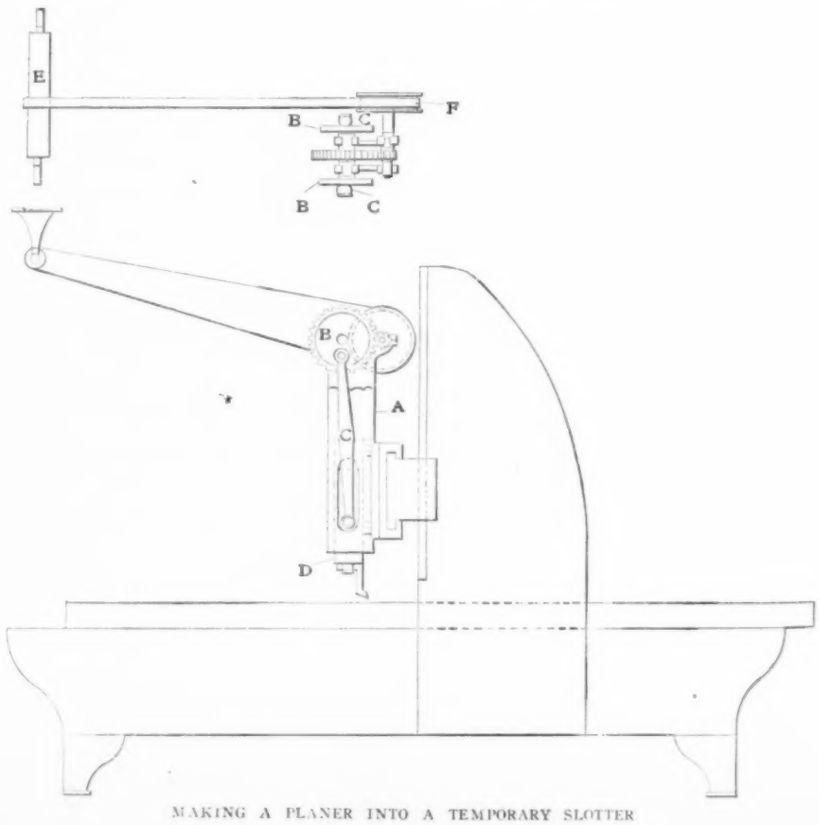
Making a Slotter out of the Planer

Some time ago we had some machine frames that we wished to face off for the caps of the bearings; as they were in such a position that it could not be done on the planer, a slotting head was fitted to it substantially as shown by the accompanying sketch.

The tool holder was removed and casting *A* was bolted to the saddle; this was fitted with a sliding head *D* for carrying the tool. A shaft carrying two crank disks *B B* drove *D* by means of the connecting-rods *C C*. *B* was geared to another shaft having a flanged pulley marked *F*, which was driven from the long drum *E*.

The device was not handsome, but it did the work well.

Philadelphia, Penn. W. ALTON.



MAKING A PLANER INTO A TEMPORARY SLOTTER

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Oil Hardening Cutters and Dies

I cannot fully agree with Mr. Markham's article, on page 63, entitled, "Use of Oil in Hardening." In Fig. 1 is a cutter which Mr. Markham refers to as breaking at the point *A*. While this piece resembles a milling cutter, it must surely be a gage and would have to be stoned to size. If it had oil applied at the bottom of the openings, it would have two distinct degrees of hardness, and would be very difficult to stone to size and not be in the best possible condition for the toolmaker. Then again, if a piece of this kind contracted enough to break at the point *A*, it would lose its shape to the extent that it would require more work to stone it down than the making of a half dozen such gages properly hardened.

I have had a great many pieces to harden where the shrinkage could not be more than 0.0001 inch. When the proper heat is found this can be done, and the article shown in Fig. 1 can be hardened with absolutely no danger of losing it. This can be accomplished by packing the piece in crushed bone and animal charcoal, in a cast-iron box, two inches larger than the piece to be hardened, and by experiment it will be found that it can be brought to the proper heat in about 2½ hours. I do not recommend this treatment for every cutting tool, and only use it in gages, etc.

As for a tool such as is shown in Fig. 2, where there is great danger of the thin piece cracking off, I would gladly use the same method that Mr. Markham has described, but this will again give us two degrees of hardness, and the tool would work all right with a given temper on one part, but the other part would not be at its best, give satisfaction in use or do a day's work.

There is nothing better than fire and water with a little oil in one corner, as is shown in Fig. 3, to give cutting tools the proper quality. This quenching bath has a partition extending across one end down into the tank about 8 inches. After having the tank nearly as full of water as desired, the oil can be poured into the part partitioned off, and it will remain in the inclosure, thus leaving the water clear of oil.

There are a great many ways of hardening tools, but when we say cutting tools then it means something beside being hard, and a tool with two different degrees of hardness can never be at its best. This is what causes me to say that fire and water with a little oil in one corner cannot be beat.

In hardening the tool shown in Fig. 2, it should be brought to a heat that will produce the proper degree of hardness, then plunged in the bath, using all the force possible to drive the piece through the water in order to cool it rapidly and sufficiently to be hard. Then pass it up under the partition *B* into the oil and hold it in the oil a few seconds before removing.

In hardening a die such as Mr. Markham speaks of and similar to the one shown in Fig. 4, he states that he heated the die to a low red and let it cool in the air, then heated it to the proper hardening heat and hardened it. Now there are a great many dies that will not stand the shrinkage of air annealing together with the shrinkage in the hardening. This will amount to considerable in both operations and but little more than half the amount if just heated to the hardening heat and hardened. Of course, it was proper to anneal the steel referred to after it had been overheated, but this should be done before the steel is made into a die if the size is to be held close.

We all know that the day has come when the tool hardener is expected to keep his work perfect, or at least within a few thousandths. In fact, I know of several tools manufactured by the company that I work for that the maximum allowance for shrinkage is 0.001 per inch. If the piece loses more than this it is charged to profit and loss and the toolmaker is started on another.

The die shown in Fig. 4 is 8 inches long, 4 inches wide, and 1¼ inches high, and was made of a good grade of tool steel. This die was heated to a good hardening heat, plunged into a salt bath and cooled with the greatest possible force until hard, and then passed up into the oil and hung on a hook to finish cooling. Then it was drawn to the desired temper (straw color), ground, and has been in use for nearly eight months, giving entire satisfaction. It was hardened without the least fear of losing except by accident.

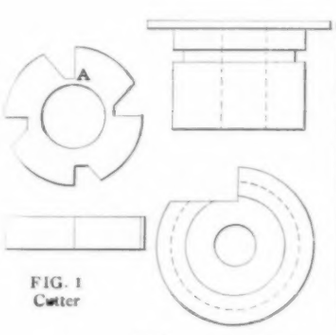


FIG. 1 Cutter

FIG. 2. Wheel Tool.

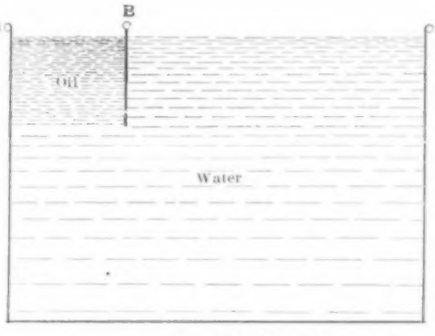


FIG. 3. Quenching Tank with Oil in one end.

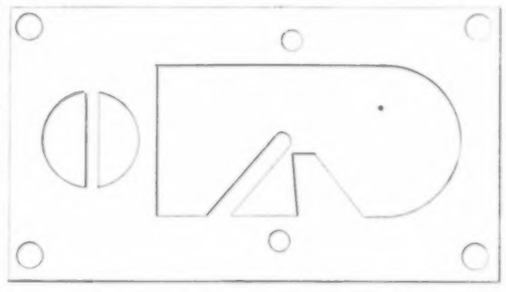


FIG. 4. Press Die. 8″ x 4″ x 1¼″

I do not pay any attention to the singeing of a piece when cooling. To harden I continue to cool until I know the piece is hard and then discontinue cooling at once. This gives the tool an even degree of hardness and enables a tool to do its best on all working parts. Of course, if the die, Fig. 3, page 63, was as Mr. Markham says, then use the oil where the corners and edges do not need to be hard, but surely not on a die such as is shown in Fig. 4.

There is one thing that I thoroughly agree with Mr. Markham on and that is that frequently a die will be made from a block of steel entirely too large or out of proportion which generally causes unequal contraction and expansion, and it would be well for our tool designers to inquire into this part, as it would save many days' time in stoning and grinding.

Davenport, Iowa. JAMES STEELE

Law and the Machine Business—Springs—Corner Shields

I was especially interested in Mr. Perrigo's article on page 41, because I have been up against this legal proposition several times, and in one of them I had a close shave and finally found myself victor in the papers and loser in cash.

I was looking after things in a shop where we were just starting out to build a type of tool new to us and wanted a place to have one or two tried out in other hands. I got wind of a concern that had use for such tools and went over to see them. They proved very agreeable to my proposition, which was that we would sell them three tools of slightly varying specifications at a price about what we would expect from a dealer and they would try them out and we would follow up the machines and if defects or weakness developed we would repair or strengthen the machines "to their satisfaction." In return we were to have our pay on ordinary terms, which usually means in 30 days, or whenever the customer feels inclined to settle.

We got out the machines and sent them over. They wrote us a letter offering some criticisms, which we placed on file to await the test of time. Two things developed, one an inconvenience in adjustment and the other a propensity of certain springs to break, of which I will say more later. We fixed both things up by having one machine at a time sent back to us, and we fixed them to their specification. Nothing more was heard of them for at least a month after the last machine went back, so we wrote them a letter asking if they would be kind enough to send us a check for the account, which at that time included one or two small bills as well as the three machines. They sent us a check practically by return mail with no comments. Soon after we had complaints that one or two things were going wrong, which we promptly attended to and so far as we knew to their satisfaction.

Four months after the check came we were surprised to see the three machines billed back to us at the railroad station. We wrote to find out what was up and they replied that "the d—— machines were never lastingly no good" and then some more after that, and they wanted their money back. We wrote them that we were holding the machines subject to their order, but that they had been so mistreated in use that we could not take them back except at a considerable discount. Four months were passed and we were attached and sued for the price of the three machines and some more for damage to their feelings, loss of time, etc. Another four months passed before the case came into court. Then we got the case nearly done and the whistle blew and the judge couldn't work any longer because he belonged to the union and his vacation began the next day, so we had to try it all over again.

The contention the other side made was that we had guaranteed to satisfy them and the only thing that would satisfy them was money. Our contention was that they must have been satisfied or they would not have paid for the machines. The judge ruled that they had plenty of time to find out whether they were satisfied or not and that once satisfied they were bound to stay so, but he also ruled that they had been damaged to the tune of $45 for the loss of the use of these machines while we were fixing them over. At that stage of the game I thought we had won, for they owed us $60 on some other accounts.

Here was where I made my mistake; instead of saying nothing about this $60, I ought to have pushed that into the case as an offset. As it was, the verdict was against us and we had to pay nearly a hundred dollars costs of court. If I had known enough to tell our lawyer about the $60 bill, we would have won by $15 and they would have had to pay the costs. That piece of information cost my company nearly a hundred, and I hope someone will have a chance to save that much money some time by buying this copy of the AMERICAN MACHINIST. Of course I was not the one who should have thought of this phase of the matter; the lawyer ought to have asked if there was any offset, and the boss ought to have known about it, but none of us did.

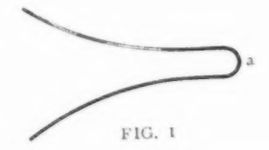


FIG. 1

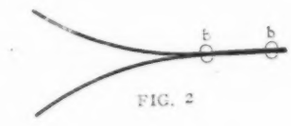


FIG. 2

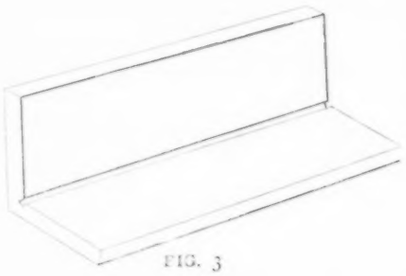


FIG. 3

TWO SPRINGS AND A CORNER SHIELD

PREVENTING SPRING BREAKAGE

By the way, this spring business is something on which too little has been said. We were using flat springs bent like Fig. 1. They broke at the sharp bend at *a* about as fast as we could make them. We got over that trouble by making them like Fig. 2, riveting the two parts together at *b b*. Of course the trouble with Fig. 1 is that the greatest bending moment comes at *a*, where the stock is already bent in so close a curve that it is not so flexible as it is where it is straight. That concentrated the stress at *a* and it broke. Fig. 2 shows a spring without short bends or kinks that will stand up pretty well, but not so well as a spiral spring, because the length of the spring is shorter as compared with the desired movement than is usual in a spiral spring, but enough better than the bent spring to be worth noting.

* * * * * * *

The suggestion of Mr. Pershore, at page 58, that builders of drills should put a taper hole through the spindle crosswise of the socket, reminds me of my own difficulties in the same line. We did just this same thing and it is all right—only we wanted to use the same bars on a horizontal boring machine. Now it is no fool of a job to get a taper hole or any other kind of a hole through a shell so that it will line up with a hole already in a bar that fits inside.

So what did we do but we made a special socket or rather a set of them, for we had quite a few bars that we wanted to interchange, and we put this socket into the drill-press spindle and drilled and reamed them both just as Mr. Pershore did and then we put this same socket into the boring-mill spindle and drilled and reamed through another taper hole a little lower and at about right angles to the first in each socket.

Then we fitted each boring bar to its corresponding socket with only one hole. Then if we ever had, as we frequently did, to make new bars we could drill and ream for the taper pin right through the socket without taking the drill-press spindle out.

CORNER SHIELDS

By the way, we needed some new brass corner shields to use when shipping or turning over finished work with the crane. We took two pieces of steel angle iron about 2½x2½x⅜ inches and planed out the inside smooth and cut a little groove in the corner, Fig. 3, and have been using them several years. They do not scratch the work as much as the brass ones did. You see the brass ones got dropped in the chips every little while and they got full of little bits of points of steel that were imbedded in the brass with one sharp corner sticking out. The steel ones did not pick up chips to any extent, and if they did they were easily cleaned out.

Fitchburg, Mass. ENTROPY.

Casting Phosphor-bronze Bearings in Place

I was much interested by the article on page 839, Vol. 30, Part 2, and should be very glad if the author or any other of

FACES TO BE CAST ON VALVE SEATS

your readers would give me further information on the subject.

The job I have in mind is how to cast hard brass rings into a cast-iron center as per sketch. I believe a somewhat similar construction is used by some valve-makers for the seats and faces.

The dimension *A* varies from 4 to 18 inches, *B* from 5½ to 20 inches and *C* from ¼ to ⅜ inch thick.

Glasgow, Scotland. W. H. BEWERS.

Another Shaper Fixture

Referring to the article on page 141 by John J. Seibert entitled "A Shaper Fixture," I wish to say that while the fixture shown and described by him is a neat arrangement, I do not consider the fixture or the apparent sequence of operations to be inferred from his article as being anything like satisfactory for the manufacture of the sight saddle shown in Fig. 4 of his article, and again in my Fig. 1.

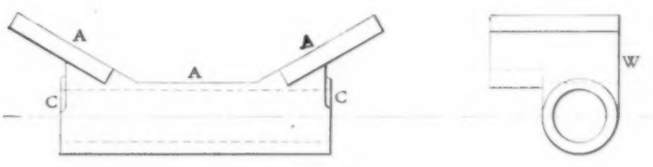


FIG. 1.

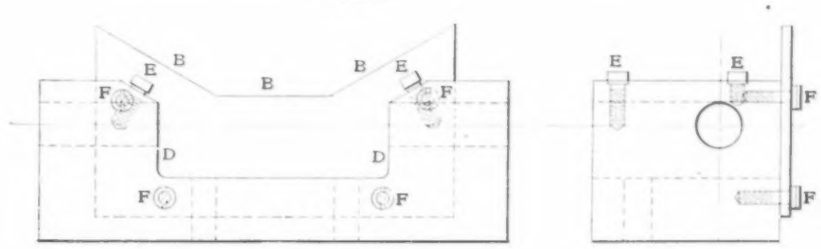


FIG. 2.

A SHAPER FIXTURE FOR GUN SIGHTS

In the first place, the jig is quite an expensive one to make and unless a large number of the sights were to be manufactured, the cost of such a fixture for the mere shaping of the saddle could not be considered in the commercial production of such pieces. In the second place, another jig must of necessity be furnished for boring the hole in the saddle, because in the finished article the hole must have a positive relation to the planed surfaces in order to insure interchangeability and correct working of the sights when pieces are interchanged, and thirdly, the accuracy of the surfaces produced by Mr. Seibert's jig depends upon the care which the man doing the work exercises to see that no particles of dirt or chips, etc., are allowed to get into the tapered seat of the locking plunger.

Having had supervision of the manufacture of very similar sight saddles, I consider the following routine of operations and fixture shown in Fig. 2 as being much more satisfactory and economical than those of Mr. Seibert, and the accuracy of the finished pieces, if the work is carefully done, will be satisfactory to any inspector in charge of the work.

My first operation on the saddle is to plane off the face *W*, Fig. 1, to form a working surface. Next, clamp the face *W* against an angle plate either in a vertical position on a drill-press table or else in horizontal position to the face plate of a lathe and rough bore the hole, being careful to leave sufficient metal in hole to clean up with finish reamer after the saddles have been rough planed on surfaces *A A A*. At this setting, also, the surfaces *C C* can be faced off true with the hole or they may be faced off later as desired. I prefer doing the facing at this setting, using a bar with double-ended facing cutter.

Next, the saddle is placed on an arbor in a fixture as shown in Fig. 2, which is clamped to the table of a shaper having set-over head for planing angular surfaces. The first operation in this fixture is to rough plane the surfaces *A A A* to within about 0.02 inch of the finished dimensions. I then remove the saddle from the fixture and arbor and finish ream the hole. Then putting the saddle on another arbor of correct size and again using the fixture Fig. 2, the surfaces are finish planed to the hardened steel surfaces *B B B* of the jig.

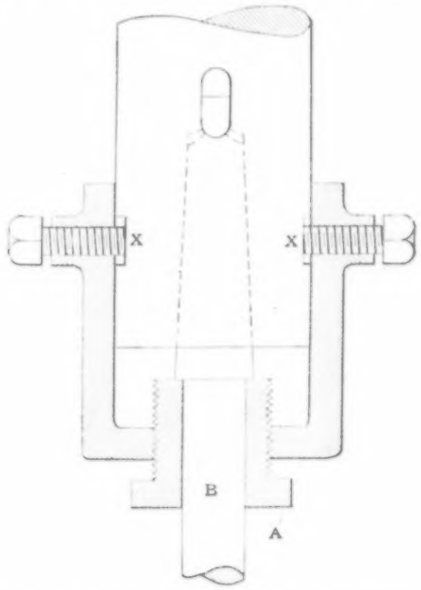
It should be here explained that the surfaces *C C*, Fig. 1, must also have a certain definite relation to the surface *A A A* so as to insure the correct location of those parts of the sights which are assembled to, and controlled by the saddle. This feature is taken care of in my shaping fixture by making the faces *C C* a very close fit between the faces *D D* of the fixtures. The four screws marked *E* on Fig. 2 are adjusted to bear on the under surface of the wings of the saddle to bring it to the correct position and to retain it there during the shaping operations. The screws *F*, Fig. 2, are for securing the hardened steel templet to the side of the jig body and are a very close fit in the holes in the templet to prevent all possible motion of it.

By using the above methods and fixture I know that perfectly satisfactory work can be turned out, that the cost of the fixture will be decidedly less than that of Mr. Seibert, and that the chances of inaccuracy are much less in my shaping fixture than in the one shown by him.

Bridgeport, Conn. WALTER CANTELO.

Another Suggestion in Connection with the Drill Spindle

On page 58 I find an improvement for a drill press spindle to hold a tool in place when it is used for facing the under side of bolt holes on pipe flanges. I have had occasions to use just such kind of an arrangement, but I cannot see how the taper pin will hold a taper shank in place so it will not chatter when any pressure is put upon it. I have made a special contrivance to hold taper-shank tools in place



HOLDING UNDERCUTTING TOOLS IN THE DRILL PRESS

for the same purpose, and with this arrangement, by using different sized bushings any sized tool can be held in place absolutely solid. All that is necessary to do is to file two flat places *X* on the drill spindle opposite each other and two flat end set screws will hold this part in place and in screwing up the bushing *A* the tool *B* can be held in place without a particle of trouble. In case the tool is made in such a shape that the bushing cannot be slipped over the end, simply saw the bushings in two and screw them home. The illustration shows this improvement.

Headless set-screws, with square holes in them, to be of the same size as the key used for the drill press should be used. I cannot see any other way to get a tight job for all tools used in this spindle; by using a taper pin you would have to have a different hole for every tool, and if you used, say, five different tools for the press, the drill press spindle would soon look like a pepper box.

Oshkosh, Wis. CHAS. KAUFMANN.

Lard Oil or Soda Water

In answer to "Questions for Shop Men and Managers," page 274, regarding lard oil or soda water for a lubricant, I would like to give my experience to the readers.

I have used lard oil and soda water, but in shops where no provision is made for reclaiming lard oil, it is too expensive to use, and soda water is equally as expensive as it dulls cutting edges more quickly. Some eight years ago I commenced using lard oil and soda water together. At first I used equal parts, but for the past three or four years I use one-third lard oil and two-thirds soda water boiled together, and find that cutting edges hold as long as with lard oil only, and give just as smooth and nice a cut as can be had with soda water. This is also cheaper than lard oil. I have successfully used this mixture for drilling, tapping, reaming, milling and on finishing cuts in shapers and planers.

I find it far superior to anything I have tried on steel castings.

St. Paul, Minn. LOUIS GLASER.

Hollow Mills for Screw Machines

At page 951, Vol. 30, Part 2, I notice that Nomad criticizes the method I suggested at page 260 for grinding hollow mills. While I was pleased to read his criticism, I hardly think he quite understands the method I recommended. Perhaps I did not make my method very clear. I claimed then (and do again now) that by hollow grinding the ends of the blades as shown by Fig. 1, the chips curl out of the way at right angles to the work. I do not mean by this that the chips wind up like a clock spring, but that they take a direction radially at right angles to the axis of the work. I could show Nomad several chips which I have in my possession at the present time, each of which is over eight inches long, and which were cut by hollow mills ground in this fashion.

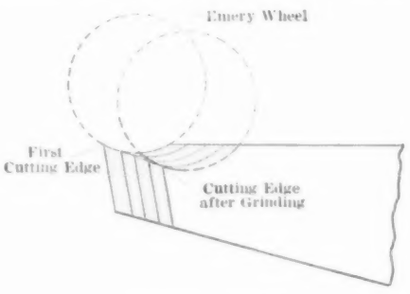


FIG. 1. GRINDING HOLLOW MILLS

When regrinding the mills, I do not grind all the metal off the front as he shows in his sketch, but grind an equal quantity off the edge and side. Fig. 1 shows what I mean. The four shaded portions show the four successive shapes after four times being ground. It will be noticed that the form is practically the same after each grinding operation.

With regard to the difficulty Nomad mentions of getting all the cutting edges level, Fig. 2 shows a fixture I have made to get over this trouble. *A* is the hollow mill to be ground, which is held in bush *B* by screw *C*. The bush *B* is free to revolve in base *D*, but is held down by nut *E*. The base carries a ball, behind which is a fairly stiff spring. The ball serves the purpose of locating the bush in the different positions, so as to bring the blade to be ground into its correct position. There are three or four V-shaped countersinks in the bush at *F* into which the ball enters, according to the number of teeth there are in the mill. The principal advantage of the fixture is the fact that the mill being held on an angle, the required clearance is always obtained, and the cutting edges are bound to be ground level.

I find that mills with three blades give best results on small work, but for larger work, I think four blades are better than three.

The bush *B*, Fig. 2, is made to take the largest size mills we use, and smaller ones are held in the same fixture by means of split bushes. I suppose it is hardly necessary to say that the indexing of the bush is done by hand, after each tooth is ground. CONRAD.

Birmingham, Eng.

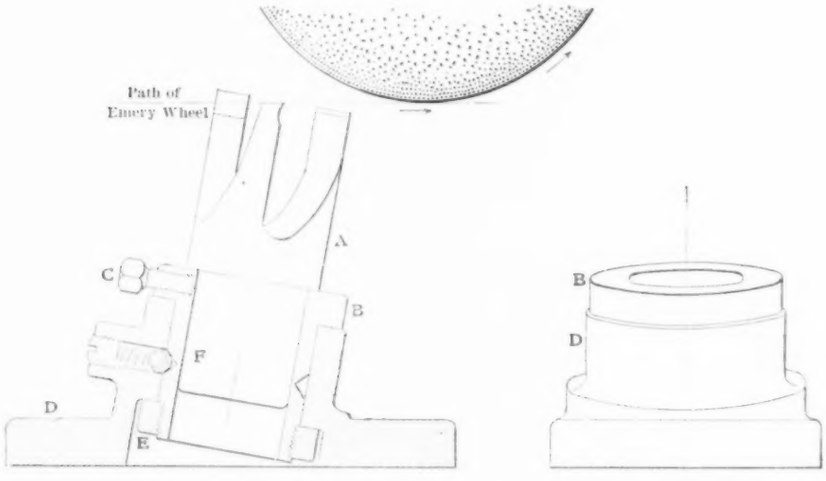


FIG. 2. FIXTURE FOR GRINDING HOLLOW MILLS

The Making of a Press Die

I have read with considerable pleasure and interest, Mr. Vogt's description of making a punch and die on the sub-press principle; the little kinks are excellent and should lead to good results if followed carefully out, with one exception which I believe will upset the whole die. On page 169 of the present volume occur the words: "If there should be a *slight* difference between *C D E* and *F G H* it would not affect the accuracy of the punching, it would affect the scrap only."

A little thought will at once show that if the distance between *C D E* and *F G H* should vary to the extent of 1/64, this will give trouble in the result all the time, as the feed which moves from *C D E* will at the same time show a discrepancy compared with *F G H* of 1/64 more or less and cause a notch on the side of the hole in the punching. This I think conclusively shows that the distance between the points mentioned must be exactly the same to secure a good result. PRACTICAL.

Glasgow

Precision Drilling and Reaming Machine

Some enterprising maker of light machine tools should get out a drilling machine like that used by the Burroughs Adding Machine Company and described at page 963, Vol. 30, Part 2. There should be a demand for it in many up-to-date toolmaking and experimental departments. It might be elaborated somewhat. A large hollow spindle adapted to receive spring chucks and fitted with a clamping device to hold it from end movement might be provided. The machine could then be used as a vertical-spindle bench miller as well. The vernier shown at *B* in the photograph should be mounted on a slide with a fine adjustment, so that it may be placed in any position along the scale. After the first hole is drilled the vernier may then be set at zero or some even inch mark on the scale, and thereby not only facilitate making the succeeding settings, but prevent possible errors.

It seems to me that for the class of work shown in Fig. 2, page 964, the kind of drill shown at *a*, Fig. 1 herewith, would be ideal. Drills like this can be made quickly from drill rod and are commonly known as cannon drills. They will follow the guide of the bushing precisely, and can be used as reamers also. For brass they work as well, and can be made more quickly, as shown at *b*, Fig. 1. They are just slanted off exactly to one-half the diameter at the end, and the proper clearance given. For accuracy they are very superior to the twist drill. The hole made will be precisely the size of the hole in the bushing, even if the drill is not a close fit in it.

I have never tested a milling-machine feed screw, and do not doubt Mr. Vincent's statement, at page 980, that they are not to be depended on where holes have to be spaced exactly to within one-thousandth inch. For fear, however, that Mr. Vincent's article may tend to give some the impression that the feed screws are not good enough for accurate work, I will say that in the best makes of machines the screws are cut with great care, and accurate spacing can be done by them. I have bored many jig plates and dies, spacing by the dials on the feed screws with excellent results. In the most refined sense it was not precision work, but the holes were at least as accurately spaced as I could have gotten them by careful laying out and boring on the face plate on an engine lathe in the usual way, using a center indicator for truing.

I would like to ask Mr. Vincent to explain how he bores the holes to exact size. He does not state that the holes in the plate were reamed, but speaks of boring the lower right-hand hole and inserting a special plug gage. Frequently we do not need to bore to exact sizes, but can grind our bushings to fit afterward, but in this case the plug had been made first. With the type of boring bar he shows, and in fact with any kind I have used, I have found it very difficult to bore to exact fits, and have always bored near to size and then reamed.

As standard taper-shank reamers will not fit the spindle socket without a special collet, I use the three-jawed chuck screwed on the spindle. If a straight-shank reamer is used it should be gripped within ⅛ inch of the end and trued up so that any lack of truth in the chuck will not affect it. I have often used taper-shank reamers gripped lightly by the taper, and trued up by tapping while running. This may not seem ideal, but as the reamer need not be gripped tightly neither the chuck nor the taper will be injured.

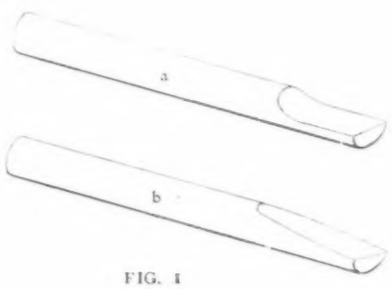


FIG. 1

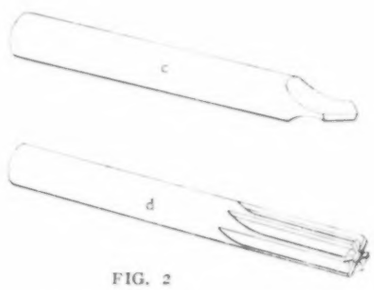


FIG. 2

DRILLS AND REAMERS FOR ACCURATE WORK

In the tool room of the Western Electric Company, Chicago, are two vertical-spindle millers, the slides of which are provided with graduated steel strips against which are verniers to read thousandths; the arrangement being similar to that on the drilling machine referred to above.

The verniers are provided with illuminated magnifying glasses. The locating of holes in all their jig and gage work including the most refined, is done on these machines. The spindle is mounted on a vertical slide having a free movement so that it can be used like a drill spindle.

The hole is first spotted with a flat centering drill like *c*, Fig. 2, then drilled through with a twist drill a little under size, and finally reamed with what they call an end-cutting reamer shown at *d*, Fig. 2, which reamer is ground true and with clearance on the end teeth only. If started slowly this reamer will locate the hole accurately even though the twist drill did not, and once started will follow through perfectly straight.

HORACE P. MCCABE.

Chicago, Ill.

Automatic Machine vs. Hand Work

On page 345, J. R. Godfrey has an article on "Selecting a Machine Equipment" and in the latter part compares the production of a boy's hand labor with that of a screw machine with the boy's production in the lead.

Let me state that in this particular case he speaks of, that of cutting off and pointing stock, the automatic is the proper place to do it, with production far ahead and the cost much cheaper than that of hand labor.

A few months ago I designed a set of cams for the Brown & Sharpe screw machine for this very same operation for 5/16-inch stock which are in use a good part of the time in our screw-machine department that gives a net production in 10-hour day of 4000 pieces at a cost of 2 cents per hundred.

I should like to see the boy that could produce that number per day at that cost, with the accuracy that these pieces have, every point the same angle and every piece the same length.

Lowell, Mass. PAUL W. ABBOTT.

Turning Rubber

Referring to C. Holt's letter on turning rubber, at page 563, Vol. 30, Part 2, I suggest that a better way to finish hard-rubber rolls is to grind them. We recently had to finish some small rubber rolls 1½ inches diameter by 1½ inches long, which came to us rough turned about 1/16 inch oversize. We found that by using a corundum wheel of the proper grade, not only could the stock be removed very rapidly, but a high finish could be readily obtained. The whole operation of roughing and finishing averaged 1½ minutes to a roll. A stream of soda water was kept on the work while being ground.

As compared with metals, hard rubber is, of course, very soft, and on this account we expected and found that heavy cuts might be taken with a grinding wheel, but we had doubts about the finish to be had. In this we were agreeably disappointed, for, as above stated, the finish left nothing to be desired, and the work was undoubtedly much truer than would have been the case had it been turned or filed.

Providence, R. I. H. A. RICHMOND.

Another Needed Change in Our Patent Law

I have just read with a great deal of interest and approbation your editorial on page 540, on "A Needed Change in Our Patent Law."

Our patent laws are so defective in some particulars as to kill our own industries for the benefit of foreign industries. Your editorial sets out one method by which they do this.

Through necessity, in consequence of the feature in the Canadian patent law of which you speak, we were compelled to establish a factory in Toronto where we now manufacture a large number of cream separators, whereas formerly we made all of them here. There is another defect in our patent law, however, which I believe even more important.

We manufacture large quantities of cream separators for use in Europe and other foreign countries. We have numerous manufacturing competitors throughout Europe. All manufacturers are striving for improvements on their machines. Each one, from time to time, makes some important improvement and patents the same in many countries, especially in the United States, where patents are cheap and easy for a foreigner to get. Some of these improvements are so important as to make a leader of any separator which embodies them.

Owing to different kinds of patent laws in other countries, they fail to give protection to the inventor and every manufacturer of cream separators in those countries is free to embody the improvement in their machines.

Owing to the United States law forbidding the manufacture of a patented invention in this country, even though it is sold to a user in a foreign country, we cannot embody the invention in question in our machines, and thus we are put out of business for foreign trade.

In other words, the German separator manufacturer, living in a country where broad patents are hard to get and sustain, has the full opportunity to profit by the inventions from the brain work of everyone in the world who is improving the separator, and can sell his machine not only in his own country but in almost every other country foreign to the United States, while the American manufacturer must depend on his own staff alone for his improvements.

You can see that under such conditions the American manufacturer is put out of business so far as foreign trade is concerned unless he does as we have done and establishes a factory in Germany, where we now make most of our machines for our foreign trade.

The United States forbids the manufacture in the United States for sale in Germany, of machines embodying inventions that are free to anyone in Germany to make and sell in almost all countries foreign to the United States, and thus compels the American citizen to abandon his own factory for supplying foreign trade and re-establish it outside of the United States.

The law should not forbid manufacture for sale in a foreign country, but allow the laws of each foreign country to control the inventors' protection in that country.

THE SHARPLES SEPARATOR COMPANY.
Westchester, Penn.

Disposal of the Products of Trade Schools

In the AMERICAN MACHINIST for March 5, there appeared an article entitled "German Trade Schools" asking for more light on these institutions with particular reference to the disposal of their products. In general, it may be said that no absolute law may be cited which is applicable to all institutions. The product is taken care of in ways as various as the schools themselves. Each has an outlet of its own that is the resultant of individual conditions which may be identical with no others in the empire. The enviroment, character of the school and administration, together with a multitude of other items are factors in the determination of this question. In some instances the city takes the product, in others it reverts to the National Government, or a local labor union may constitute the channel through which the material passes.

This article will deal solely with the problem as applied to conditions in the United States and will attempt to offer a solution to those who, while intensely interested in the recent movement looking toward the establishment of industrial schools, nevertheless raise a question of such vital importance to both manufacturers and representatives of labor—to whom and in what manner shall the product of industrial schools be disposed of?

It is generally conceded by both capital and labor that vocational education is desirable but a feeling is generally prevalent that undesirable competition will ensue; that products approximating prison-made goods will through this means be put on the market. That no such result is to be reasonably expected is the conclusion of men competent to judge after giving exhaustive consideration to this very phase of the problem.

In commencing the study of this subject, the two possible types of industrial schools must be carefully differentiated.

1. The school which plans to manufacture a definite line of goods for the market.

2. The school which will direct its energies into some other channel.

The first type of school is no longer being considered by the majority who have studied the situation, for it seems not quite feasible in a public institution, although its premises are not altogether untenable. Let it be stated as a fundamental and unalterable principle that in all work done by a school, perfection would be demanded and nothing less accepted. Articles of superior excellence do not go begging and if only such were offered at prevailing market prices, disregarding the size of the scrap heap accumulated meanwhile, no intelligent and reasonable individual or association should decry the institution producing them.

A staple article in general demand would yield the best results for school manufacture. Something of such size that it would not tax the strength of the workmen in manipulation, that could be readily handled by the equipment of the plant, that did not duplicate any line of work carried on by a local enterprise and that would afford as large a number of different machine operations as possible should be selected. The determination of the thing to be made would be in the hands of local authorities and should not be a problem of much difficulty.

As an example of the foregoing, a lathe chuck suggests itself as nice work is imperative in its construction and it offers as great a variety of machine work as is often found in a piece of equal size. It includes lathe exercises of all kinds, drill-press operations, thread cutting, gear making and jobs for the milling machine, shaper or planer as well as general assembly work, while commercial shop practice involves the use of a large number of special tools, jigs and fixtures indispensable to modern production methods. On opening a school, there would be, of course, nothing of this nature on hand, and hence, the design and building of such apparatus, as the need for it became apparent, would be an important feature in the curriculum.

While a plant as complete as circumstances permitted would be installed and up to date methods followed, the fact that imparting instruction and not the production of a large amount of stock was the fundamental motive of the school; with perfection demanded and the scrap heap the destination of anything not up to the high standard set, makes it evident that the product turned out would not be of sufficient magnitude to make an appreciable difference in the market.

The second plan mentioned, that of a school which will direct its efforts toward some field other than manufacturing a line of goods for the market, commends itself at the present time more strongly to students of the problem than the one previously referred to. Several excellent lines are available against no one of which, in my opinion, can plausible exception be urged. The general scheme takes a school at its very inception and provides it with a harmonious, progressive and logical field

of usefulness that gradually develops from the most elementary to the most advanced operations.

The plan stated in concise form is this, so far as may be, let every school manufacture its own equipment, and to anticipate any expressions of derision, the proposition shall be unfolded as broadly and simply as possible. I am neither so visionary nor so little acquainted with the probable capacity of pupils of an industrial school as to presume them capable of building machine tools, wood-working machinery or similar things, at least not immediately and perhaps not even eventually.

When the first school in a district is opened, it should contain a fairly complete and well-equipped machine shop and the more necessary wood-working tools, and be well provided with work benches together with the accompanying paraphernalia and have besides, a small forge shop. With such a plant to start on, the first article of manufacture would naturally be drawing boards, each student completing his own under the supervision of his instructor. A place to lay the boards would logically come next; so the details of saw horses should be worked up on the drawing board, the stock sheet be prepared, costs figured and the articles constructed in the shop. When strips of board had been laid across the horses, a rough-and-ready table would be provided and the drafting room will have come into existence. The whole scheme is a systematic development of this general method. As manipulative skill increased, with its accompanying wider judgment and ripened experience, the plant of the school could be more and more perfected and improved with a corresponding increment of usefulness and efficiency.

In other shops, the metal working for instance, similar activity is possible. All small hand tools like cold and cape chisels, punches and drifts, lathe tools, screwdrivers, flat wrenches and machinists' hammers are within the scope of the institution and every one enumerated is essential to a machinist's kit. As workmen became expert, more ambitious projects naturally would be attempted. Machinists of an earlier day usually owned a few pairs of friction-joint calipers which, in practiced hands, were susceptible of fine adjustment and permitted the delicate feel so essential to accurate work, and instruments of this nature could be produced by each pupil for himself.

In the realm of shop equipment, tool making is permissible. Milling cutters, straight-flute and twist drills, reamers, taps, mandrels, snap, ring and plug gages, in fact almost everything in the line of small tools required could be produced by the plant itself.

This suggestion is, of course, not merely applicable to a single school, but opens up a field where many institutions might operate for a long while without exhausting the possibilities. Each might build for another or all combine to furnish the partial equipment for a new establishment. The limits of the proposition are far reaching, for with the progress of time and the inevitable enhancement of manual skill and intellectual acuteness, plants after being installed could be made practically self-sustaining as far as up-keep and the purchase of new machinery is concerned.

Another plan offering great opportunities, after the equipment of an institution has been brought to any desired state of perfection consists in buying, thoroughly overhauling and reselling second-hand machinery. This line of work, if pursued for its educational advantages, enters into competition with nothing with which the writer has acquaintance. There are, it is true, dealers in second-hand machinery, but the bulk of overhauling any particular machine is accorded consists, usually, in giving it a coat of paint and polishing the bright work. This proposition is far broader. It meditates the careful selection and purchase of such types of machines that intimate personal knowledge of them would be beneficial to the students. Such machines should be dismantled, thoroughly cleaned and rigorously inspected to locate all broken and worn-out members, which should be replaced in the manner surrounding conditions indicate to be the most desirable. Afterward, the parts should be reassembled, the machine tested and disposed of. This line of work closely approximates that of the old-fashioned job shop where everything conceivable was undertaken and any job accepted that could be gotten through the door. No greater possibilities for acquiring excellent experience, developing sound judgment and inventive ingenuity, and of compelling a thorough mastery of the machinists' trade in all its ramifications seem, at this moment, to be offered by any other plan of equal simplicity.

In connection with a school and adaptable to every plan enumerated, there should be a commercial department where students could be trained in all operations naturally devolving on any shop office, in order that by intimate association and actual experience there might be reached an adequate conception of the interrelation and the inseparability of time and money. Estimates of time on all jobs should be insisted on from the very beginning, together with a computation of the cost of materials involved. This department would purchase all supplies, including the second-hand machines previously referred to, and would do the accounting incident to the disposing of products. Further, it would have charge of all internal finances of an individual school together with its relations to other institutions of a similar nature. A study of the functions of freight receipts, bills of lading, shipping orders, invoices, tracers and the like would here be profitable, as well as methods of routing freight to all parts of this and foreign countries. In this single field lies great opportunity for acquiring knowledge of procedure of which too many are totally ignorant.

These suggestions are offered without the doubt that to them may be added many others by men interested in the future of American mechanics to whom industrial schools are opening doors of logical preparation for wide usefulness in chosen vocations which, it was feared, were being closed to them forever.

TRUMAN D. HAYES.

Cambridge, Mass.

Why Does a Drill Cut?

This problem shows plainly that when cutting tools are so hard that a file will not touch them, their efficiency and durability are gone. The author of this interesting article does not state the cause, or give any explanation, but leaves it for the readers for consideration and solution, and I will explain as it seems to me.

Total hardness is not necessary in any drill or tool, if it be for cutting metals or wood, with the exception of brass, copper, or like metals, where the tools cannot be too hard, as the effect on those metals is just the opposite to iron, castings and steel; also when cutting timber.

The drills, when of the proper temper, not too hard, will swell outward from use and increase the cutting edge from the stress due to drilling. This is almost like grinding it automatically while in use, and you will notice that the lip of the drill will wear concave from the cutting action of the material as the chips pass from under the cutting edge, and this is evidently the cause of the startling results. This is impossible with drills and tools when too hard, as the efficiency is only had when a perfect cutting edge is maintained. When that is gone, from the drills being too hard, they will round on the edges, as it is impossible to swell.

I would call the attention of those that have had experience with cutting tools on a lathe, planer, shaper, etc., and have no doubt that they will bear me out that a tool which has the proper temper is one that can be readily filed. You will notice that the point of the cutting tool will wear concave, leaving the point intact as the chips pass from under the cutters; this will not occur in a tool which is too hard, and this is the precise theory in drills that cut and don't.

I have also had a similar experience with cold chisels, and have done good work when they could be sharpened with files without grinding, standing the hardest kind of usage. I have no doubt that many of the readers have had a similar experience.

Louisville, Ky. HERMAN FLETCHER.

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Increased Efficiency of the Patent Office

For more years than we care to recount, there has been a never failing stream of complaint at the inefficiency of the Patent Office due to the lack of a sufficient number of examiners to keep abreast of its business, and to the fact that the constant changes going on in the personnel of the office lead to a low state of efficiency, to the detriment alike of the character and quantity of work done. Against this and adding to the feeling of dissatisfaction at the conditions, is the fact that the office is, and for many years has been, a source of profit to the Government sufficient to pay for the services of an adequate examining force.

There is now before the House of Representatives a bill designed to remedy this condition of affairs, which bill has been favorably reported upon by the committee on patents and deserves the support of every manufacturer and inventor in the country.

The explanation of the constant changes in the personnel of the office lies in the meager salaries paid, combined with the increasing opportunities for men having the training which the office gives. This training is, of course, exactly suited to the work of a patent solicitor working independently, as an employee of some solicitor with an established business, or with one of the numerous corporations who now employ solicitors of their own. With the limited prospect for advancement offered by the office, and the better opportunities outside, the best examiners resign after acquiring the necessary knowledge and experience and just when they have become useful to the office, in order to engage in outside work, their places being filled with inexperienced men whose efficiency is necessarily far less than those who have left.

Under the present conditions an assistant examiner enters upon his work with a salary of $1200 per annum, the ordinary maximum obtained after many years of service being $1800, with a rare chance of promotion to the position of principal examiner at $2500. When it is remembered that most of the examiners are graduates from law or technical schools, the meagerness of the prospect is apparent, and as a matter of fact the best men who enter the service do it with a view of resigning after obtaining the experience which the work affords. It has been stated that of the personnel of patent law offices throughout the country, two-thirds are graduates of the Government office.

Under these circumstances it is not surprising that the Civil Service Commission has been unable to supply the office with the required number of certified men to fill the numerous vacancies which occur.

The bill now before Congress contemplates an increase of 48 in the number of examiners, the increase being from 313 to 361. The initial salary is to be $1500 per annum instead of $1200, the difference between the old and new salaries increasing with the term of service, the rate for the highest grade of assistant examiner being $2700 against the old figure of $1800. The rate for principal examiners is increased from $2500 to $3000 and that for examiners-in-chief from $3000 to $4000.

The gross effect of the bill will be to increase the expense of the Patent Office by $331,900 per annum. This increase exceeds the surplus of last year by $52,740, although it exceeds the surplus of 1905 by only $4776.

There is no question that this bill ought to pass. The conditions have been a standing reproach for years, and it is a most obvious measure of justice that the revenue of the office should be expended in its own administration.

Every reader who is, and every reader should be, interested, should write at once to his member of Congress endorsing this bill and giving its number—H. R. 15,846.

A Dense-air Hoisting Engine

We learn from *Engineering* of recent date that a noteworthy advance in compressed-air engineering has been recently accomplished by Fullerton, Hodgart & Barclay, of Paisley, England, from the designs of H. C. Behr, a South African consulting engineer. The piece of work referred to is a dense-air hoisting engine for use underground in South Africa.

The dense-air system consists essentially in raising the exhaust pressure of the engines and the intake pressure of the compressors to a point far above the atmosphere, in this case to about 60 pounds, the working pressure being 155 pounds. The exhaust of the engines and the intake of the compressor are connected by a line of piping additional to the usual pressure system, the same air being circulated around the system indefinitely. This system originated with Charles Cummings, of San Francisco, and was first intended for use with rock drills. In this application it has found little use because of the objectionable feature of the second line of pipes and especially of the double hose connections. It has, however, been used to some extent in connection with pumping operations, but it has never had an application comparable in magnitude with the hoist now referred to. The engine is of the first-motion construction with the hoisting drums mounted directly on the crank-shaft, the drums being 10 feet in diameter, and the twin cylinders 26x48 inches. The machine will thus be seen to be of considerable magnitude, and it will undoubtedly be closely watched by mining engineers.

The advantage of the dense-air system

lies in a marked increase in the efficiency of the system over the usual one, the efficiency of the new system being fairly comparable with that of electricity. Along with this go a large reduction in the size of the compressor and in the consumption of fuel as well as large advantages from the entire elimination of the difficulties growing out of the accumulation of frost due to the expansion of air as commonly used.

Profitless Haste

New surroundings, or unusual conditions amid familiar surroundings, often change our viewpoint, shift the angles of our perspective and enable us to see everyday conditions in a new and more profitable light. The lessening of business activity and manufacturing hustle brings about a change of conditions in familiar surroundings, which allows us to think of some things in a different way than would be possible if all of our energies were concentrated upon production. One such feature, which it is worth while to consider, is profitless haste.

At the outset this characteristic of our industrial life must be clearly differentiated from that most estimable and important quality, American alertness. But the word alertness, even when amplified by the word American fails to adequately convey the idea of intense watchfulness, of keen sensitiveness to opportunity, of precise summing up of possibilities, of eager grasp of the essentials of a proposition and of the activity and earnestness of execution which are such vital elements in American business life, and which contribute so much to our industrial supremacy.

Profitless haste springs from this same quality through its misdirection. It is present in many manufacturing establishments and causes a direct loss of time, of money, of things undone and of nervous energy and stamina among the executives. It is a loss of time as it fritters away minutes, hours, even days; such time would better have been spent in idleness. It entails a direct loss of money, for "time is money." It causes a loss of opportunity, for wasted time might be spent in useful production. It causes a loss of nervous force for, considering the results which might be obtained, more units of effort are required for profitless haste than for clearly planned and executed actions.

How many times does a general manager demand a report on a particular subject in half an hour's time, emphasizing his request by the statement, "Make that report the object of your existence until it is delivered to me." Sub-executives and clerks hustle and rush looking up data, running through computations, making estimates, tabulating, and finally produce a report which is, perhaps, delivered only a few minutes beyond the time limit which was set. The condition of *haste* in an office at such a time would be apparent to the most dense observer. The element of *profitlessness* is shown when, without looking at the report, the general manager shoves it into a pigeon hole of his desk to lie undisturbed, unopened and unthought of until covered with the accumulated dust of months. A clear conception of when that report was needed and a request that it be prepared to meet a date far enough in the future to allow of intelligent and efficient preparation, would have met the conditions in a far better manner and freed the incident from the undesirable element of profitless haste.

How often is a purchasing agent requested to rush this or that particular shipment of material? As a result telegrams, long-distance telephone calls, transfers from freight to express channels, telegraphic tracers, special forwarding agents, etc., are called into service in order to get the goods. Perhaps six months afterward, when the purchasing agent passes through some out-of-the-way corner of the stock room, he sees this very material, whose delivery was hastened, lying quiet and undisturbed in exactly the form in which it was received after all of his tremendous efforts to get it to its destination on some particular date, conceived in ignorance or set by somebody's whim. How often is the office boy sent to this or that market, with instructions to get such and such a package and bring it out "as soon as possible." The youngster does as he is told, but the only good that comes from it is the exercise of his muscles.

We are not counseling leisurely methods of thinking or of execution, but we are pointing out the economic waste which comes from hurrying, unplanned action. We must study and adopt all of the elements which will increase our industrial effectness. Here is one of them. When business revives and manufacturing activity returns, keep alert, keep hustling, but "cut out" profitless haste.

New Publications

POWER AND POWER TRANSMISSION. By E. W. Kerr. 366 6x9-inch pages and 264 illustrations. Second edition. John Wiley and Sons, New York. Price $2.

This second edition presents a volume somewhat larger than those of the first edition. The chapters on steam turbines and valve diagrams have been rewritten to bring them up to modern practice. Additional matter has been added to the subjects of heat and the use of steam tables and the steam table of the old edition has been replaced by one more complete and better adapted for the solution of problems.

AN INTRODUCTION TO THE STUDY OF ELECTRICAL ENGINEERING. By Henry H. Norris, 404 6x9-inch pages and 179 numbered illustrations. John Wiley & Sons, New York. Price $2.50 net.

This is an elementary text book intended to lay a foundation for analytical work in electrical engineering. The subject is approached from the standpoint of the student's personal knowledge of things and phenomena connected with the applications of electricity. Every-day, familiar experiences are made the basis of the work. From these a clean conception of the governing laws is developed by combining with the results of scientific research. Considerable space is devoted to historical development; several charts show the important discoveries, the investigators responsible for them, and their chronological sequence. Six chapters, covering 155 pages, take up the construction, installation and operation of generators, motors, transformers, lighting and heating equipment and power stations. The author's preface states "In combination with practical experience or with laboratory exercises it should be sufficient to enable the student to intelligently select, install and operate electrical machinery." We question if the instruction derived from this work plus laboratory exercises would be sufficient to turn out a constructing and operating electrical engineer, yet as an introductory text book it is well written. The style is clear, the selection of comparisons and references happy and it is free from extremely technical and philosophic terms which would tend to confuse the subject. It is interesting to note the author's viewpoint of electrical engineering as one of application; the viewpoint from which he wrote the work. He says: "Electrical Engineering, once possibly a separate profession, is no longer such, but is becoming more and more a component part of general mechanical engineering."

Personal*

Charles A. Clarke, of Hill, Clarke & Co., Inc., goes abroad on April 16 and expects to visit the principal countries in Europe in the interests of his concern.

J. L. Osgood, dealer in machinery and tools, Buffalo, N. Y. sails for Europe on April 22 and expects to visit England, Germany and France, mainly in the interest of his patented tool handles.

Charles E. Crofoot who has been connected with the Boston Gear Works for several years has recently accepted the position of chief draftsman with the New England Gear Works, Boston, Mass.

*Items for this column are solicited.

A Cross-drilling Attachment for the Automatic Screw Machine

By J. Acton

Having quite a variety of work which required a hole drilled at right angles to the axis, I designed and built this cross drilling attachment which has worked so satisfactorily that I am sending you illustrations and a description of it. The attachment was made for a National-Acme automatic screw machine.

Fig. 1 shows the attachment at work and Fig. 2 is a front view of the attachment, *A* and *B* being the bars, which are attached to the sliding head of the machine, for imparting to the tool holder *C* the downward and upward movement in the dovetailed slide which is on the back side of *C*. This is no doubt familiar to those who are acquainted with this make of automatic. When the head which carries the boring, facing and threading tools travels forward the bar *B*, operating upon the roller on the back of *C*, forces the toolholder downward, and when the head travels back the bar *A* draws the tool holder upward by means of the roller shown above the bar. *D* is a strap and *E* the bolt which is used to secure the attachment to the tool holder. *E* is the machine-steel body of the attachment and *F* is bored taper, as shown, about ½ inch to the foot and bronze spindle boxes are fitted to the taper, these bronze bearings being split and a key set in the steel body to prevent them from turning. The bearings are threaded on each end 16 per inch square thread to fit the adjusting nuts *G G* by means of which the spindle is kept always in proper adjustment, which is essential, as a slight amount of play in the bearings will affect the accuracy of the drilling when drilling holes through rods of small diameter.

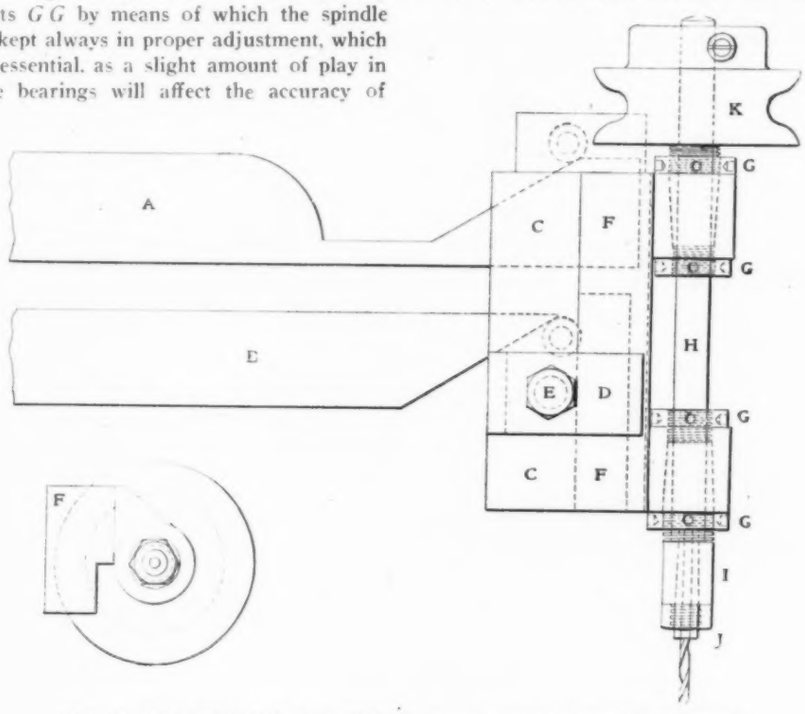


FIG. 2. CROSS-DRILLING ATTACHMENT FOR AUTOMATIC SCREW MACHINE

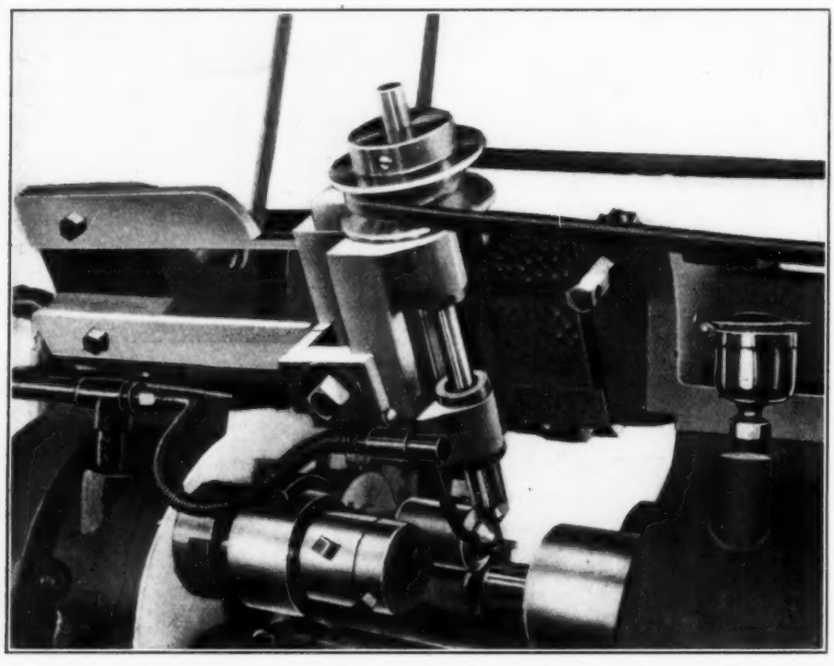


FIG. 1. CROSS-DRILLING ATTACHMENT FOR AUTOMATIC SCREW MACHINE

is provided with a tongue as shown which fits the slot in the tool holder *C*. This tongue is made just the right thickness to bring the drill point on the center of the work spindles of the machine, which is commonly called by the operators of this machine the third position.

H is the spindle which is of crucible steel ½ inch diameter except at lower end *I*, where it is ¾ inch. It is bored 7/16 inch taper to the foot to receive the drill holder *J*, which is made of steel and drilled with the same size drill it is designed to hold; the drill being soldered, or "sweated," securely in place. This was done after finding that a drill chuck was impracticable for this work as the diameter of the drill chuck was so large that in some cases it would not allow the drill to be used close enough to the end of the work spindle of the machine to prevent the rod being operated upon from springing. Also a drill soldered into a holder is much more firm than when held in an ordinary chuck. When a drill is to be replaced it is only a few minutes' work to "tin" with solder a new drill, heat the holder until the solder melts, pick out the old drill and insert the new one.

K is the cast-iron pulley which drives the drill spindle and is secured to the latter by means of a brass rod filed flat and taper on one end and drawn against the spindle by a screw, as shown.

The pulley *K* is grooved to fit a 7/16-inch round belt which passes around to grooved idlers secured to the body of the machine, and then up and around the grooved pulley on the countershaft.

A coil spring attached to the ceiling by a stout cord and attached to the tool holder *C*, so adjusted that the spring will just lift the weight of the tool holder and the drilling attachment is of service when using the attachment at a high speed, as then you need only to adjust the gib of the tool holder bearing so it will slide freely, as the spring will prevent the drill from coming into contact with the work with a jump.

This attachment has been used for drilling holes of various diameters and lengths and found to be perfectly satisfactory in every way.

Backing-off Formed Cutters in the Milling Machine

By J. E. Poorman

The illustrations show how we rigged up to back off the teeth on some formed milling cutters.

Fig. 3 shows an auxiliary slide which we had on hand, which was made for getting a rack and pinion feed parallel with

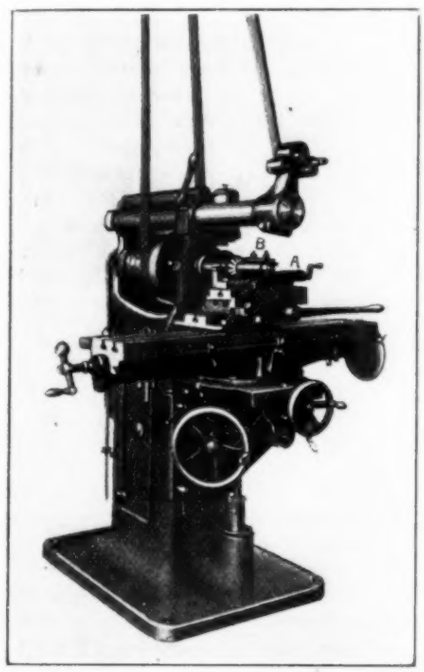


FIG. 1. SHOWING THE TOOL ADJUSTMENT

the spindle on a Brown and Sharpe hand miller.

This slide was mounted on the table of a No. 2 Brown & Sharpe Universal miller as shown in Figs. 1 and 2, it being necessary to use the raising block and parallel strip underneath it in order to clear the gear shown at *X*, Fig. 3.

Referring to Fig. 2, *A* is an angle block bolted to the slide and carrying a hardened block bearing against the cam *B*. *C* is the cutter being formed.

Back of the arbor and not so clearly shown is mounted on the slide the com-

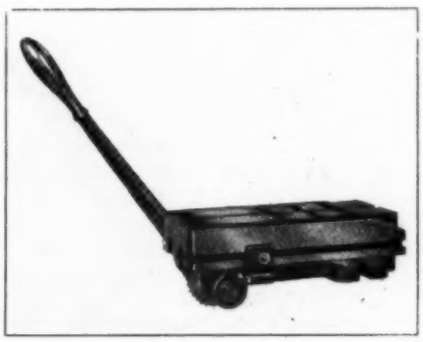


FIG. 3. THE SLIDE

pound rest taken from a 14-inch Hendey Norton lathe; this is best shown at *A*, Fig. 1. This gave us the necessary tool adjustment for the flat forming tool which was bolted down to the top of the compound rest by the two bolts *B*, Fig. 1. In operation a weight was hung on the handle *D*, Fig. 2; this kept the hardened block carried by *A* in contact with the cam *B*. The machine running in a left-hand direction the rise in each tooth of the cam would pull the entire slide forward causing the forming tool to cut the necessary relief on each tooth of the cutter *C*. The abrupt drop of each cam tooth allowed the weight on *D* to pull the slide back ready for the next tooth.

In taking the photographs the over-head arm was thrown out of the way in order to get a better view; unfortunately, owing to poor light I could not get a view from a side which would more plainly show the compound rest and forming tool. The entire rig was made up of appliances already on hand and they made a good job of the cutters.

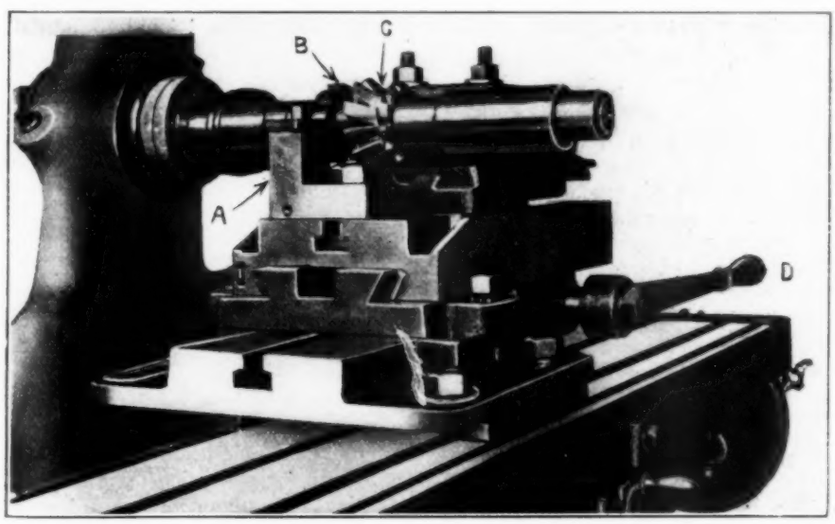
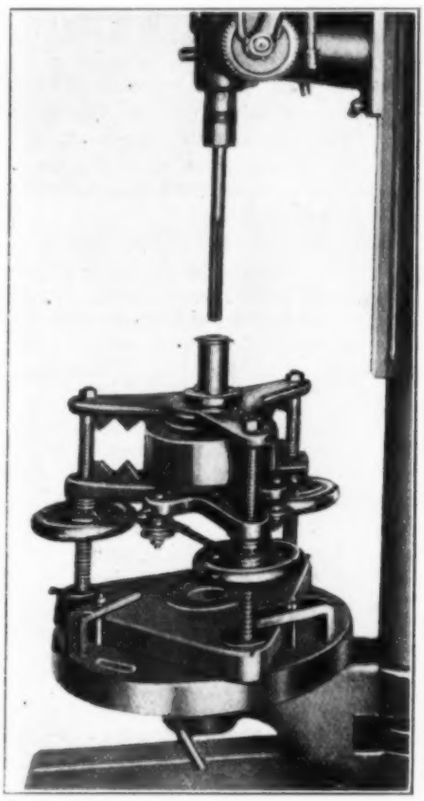


FIG. 2. THE RIG IN POSITION

Chuck for Holding Pulleys

This illustration shows a novel chuck recently designed and patented by the Rockford Drilling Machine Company, of Rockford, Ill., as quick means for centering pulley castings for the hub boring and reaming operations. It consists of an upper plate, the lower side of which is a series of V-shaped jaws which are turned in a lathe at the same time that the cen-



CHUCK FOR HOLDING PULLEYS

ter hole is bored, making them absolutely true with the line of the bushing which is placed in the center hole. The lower plate is made in precisely the same way.

The upper plate is held stationary on the top of three stationary studs on each of which is cut a reasonably coarse pitch thread. The lower plate is practically a duplicate of the upper one with this exception, that instead of being stationary it is adjustable vertically on the three stationary studs by means of three hand wheels, the hubs of which are threaded.

Fastened to the hub of each one of the hand wheels is a sprocket by which they are connected with an endless chain, the slack of the chain being taken up by an idler. In operating the chuck any one of the three hand wheels being turned will lower the bottom plate. The pulley is then laid in place on the V-ways of the lower plate. Either hand wheel is turned to the right and the lower plate and pulley are raised until the rim of the pulley meets the V-ways of the upper plate.

Just before tightening the chuck a pin is dropped through both plates, also between two of the spokes of the pulley and is twisted against same as a means of preventing the pulley from turning while the boring and reaming operations are being done. The chuck will take pulleys from 4 to 14 inches in diameter and can be operated on either a single or multiple spindle drill press.

Exposition of Safety Devices and Industrial Hygiene

At the rooms of the American Museum of Safety Devices 231 West 39th street, New York, on Saturday, April 11, were held the opening exercises of the annual Exposition of Safety Devices and Industrial Hygiene.

The exposition was thrown open to the public on Monday, April 13 and will remain open until June 1, 1908. No admission fee is charged and the doors will be open to all those who wish to attend from 10 a.m. to 6 p.m. every day except Sunday.

Its aims and objects are to encourage the invention and application of devices which will protect the life and limb of the American workers and others in all branches of activity, notable among which are manufacturing, mining, transportation by either land or water, chemical and other industries as well as for protection from fire, water, electricity and other sources which lead to injuries or the loss of life.

The museum is not coercive, but suggestive, and places on view the best known safety devices so that the industrialist may select the one best adapted to his needs and its desire is to become the experimental laboratory for every industrialist in the United States for these devices.

In the exposition no charge is made for space but an entrance fee of $5 is charged each exhibitor. Exhibits must be passed on and accepted by the committee of exhibits before space will be alloted them.

Opening Exercises

The opening exercises were held on the sixth floor of the McGraw building and were opened by Chas. Kirchhoff, chairman of the committee of direction, who introduced Dr. W. H. Tolman, the director of the museum, as the first speaker.

Dr. Tolman, said:

"The exposition of safety devices, opening today, is not the ordinary exposition, but concerns the sanctity of human life, which has been so many years in the making and perfection. How best to protect life and labor is the task set before the museum. Other countries have pointed the way by the establishment of museums of safety which are organized in ten capital cities of Europe.

"The exposition opening today is a small endeavor to point the way for the future. America, the leading industrial nation, should have the greatest museum of safety, which should serve as a center for the display of simple and inexpensive safeguards which will not interfere with the output of the machine. If such safeguards do not exist at the present time, I have belief that the inventive genius of America will focus its energy in this direction.

"The land and a building for such a museum in New York will be expensive, but there is plenty of money for such a plant, which should be located here, where the latest and best appliances may be shown. This work should be carried into our schools and universities, so that in the coming days it may not be a new thing, but a matter of course. It is educational work for showing the practicability of these appliances, not alone for the machine, but for the hygiene and sanitation of the workman, the protection of his home as well as his shop.

"The museum should contain, as in the Munich Museum of Safety Devices, an Inventors' Laboratory where, under the direction of the committee, special problems may be taken up and investigated. Only the other day, Chief Croker of the Fire Department, called attention to the fact that the Collingwood disaster was a nine days' horror. What is it today? Merely an incident in the busy rush of life. At the time of this disaster Germany scathingly observed that it was about time that the United States paid attention to the safety of the lives of its citizens and workers, stating that its Government considered it the chief importance to protect life and limb.

"We have shown what this movement will mean for our nation, and appeal for support to every citizen, not alone for money, but for the personal influence which will win friends for the movement."

Walter C. Kerr

Walter C. Kerr, of the firm of Westinghouse, Church, Kerr & Co., engineers and contractors of constructional work, was the next speaker, and said that the modern engineer was one who went into all of the details of construction in designing the different apparatus necessary to perform work with and would therefore be the man who placed all the safeguards possible around the work to protect human life and limb. The engineer of the present day who would construct a building that was not fireproof, who would design a machine that was not safe for the workman to operate, or who would build a railroad or steamboat that was not safe for those operating and using it could not be called a modern engineer, but would have to be classed with those that were not up to date, or with those that were too careless to hold the responsible position of modern engineer.

Engineering has advanced to a position today which has made it necessary to divide it into many divisions, each one of which has made the man a specialist in the line which he has adopted, and, therefore, it is a duty imposed on him by society to know and apply the best ways of protecting humanity from loss of life or from injury in the different things which he is called on to design or construct.

The science of engineering has reached such a stage of perfection at the present time that the modern engineer cannot offer the excuse of ignorance when the work which he has been called on to perform fails and the failure entails the loss of life, or serious injury to those connected with it, and therefore the municipality, State and nation are beginning to take steps to make the modern engineer responsible for accidents legally as he surely should be held responsible morally.

Prof. F. R. Hutton

The next speaker on the program was Prof. F. R. Hutton, who said:

"Industry has been concentrated to such an extent that we live today in large communities which require large building and manufacturing plants and the means of transportation, communication and distribution must be adequate to the size of the community. As this blends the lives of the individuals very closely it makes each one morally responsible for the injuries which may be inflicted upon another and the ten commandments are just as applicable to our manufacturing and commercial life as anywhere else. Thus when an engineer designs a machine that kills, or designs a building that burns, or constructs a factory that poisons with foul air and poisonous vapors, the commandment that says, 'thou shalt not kil' should be applied to him just as much as though he had taken a club and crushed in the skull of his fellow-man.

"If one designs a machine so badly that it cuts off a finger, gouges out an eye, or crushes an arm or leg, the commandment which says, 'thou shalt not steal' should be applied to the guilty party as much as though he had stolen the man's tools, his pay envelop, or any of the things which enable him to earn a living.

"The commandment which says, 'thou shalt not covet' likewise ought to be applied to those who covet money so much that they will not spend it for appliances to protect the lives and limbs of their fellow-man.

"Those who have had the opportunity to become more educated and thus hold more responsible positions than their fellow-man through being more talented, or having a greater ability, should consider it a duty which they owe to those that are less fortunate to see that they are

protected by properly designed and protected buildings, machines, etc."

PROF. C. E. LUCKE

Professor Lucke, of Columbia University, followed by saying:

"The deaths by accident and the injuries of various degrees are very large in this country and this organization ought to make a great effort to encourage the invention and adoption of appliances which would reduce these to a minimum. The appliances should be of such a nature that they would not increase the cost of the goods manufactured if the device was for protecting a workingman from a machine.

"The United States Steel Company has established a good rule, which if followed by other large corporations, would result in a large amount of good, and that is, they have sent out an order which says safety appliances should be put in wherever possible and the cost of these will not be charged up against the department using them so that the earnings on the capital invested will not be a barrier to their use."

DR. JOSIAH STRONG

The next and last speaker was Dr. Josiah Strong, who holds a position with the Government at Washington. He said: "Everyone is tender-hearted, although the hard knocks which many have received have seemingly coated them with an iron-clad armor. This armor, however, is made with joints and it is possible to get through these joints if the right methods are used.

"The loss of life and the injuries given to the workers and others in this country are something appalling when we compare the figures with the losses sustained by wars or the losses which other countries have in the same industries.

"It is estimated, and the estimate is very conservative, that 525,000 persons are injured annually in the United States, this being more than were injured in the five biggest battles of the American Rebellion, and that by men who were armed with the latest improved weapons with which to kill their fellow-man. In this country 57,514 met violent deaths in the year 1900, which was 20,000 more than the average killed per year during the four years of the Rebellion, and would amount to 80,000 more than were killed in the four years. In some industries three and four times the number per 100,000 are injured in this country than are injured in any of the European countries, and in any industry in which statistics are available the European nations have less than one-half the injuries which we have. This is largely due to the fact that the European nations have national museums of safety devices, and through these laws have been passed which force their use and the time is ripe for this Government to establish national museums in all the large cities, as France and Germany has already done.

"This organization does not go to those interested and say your money or your life when it wants safety devices installed, but it does say your money or somebody's life and somebody's money or many lives."

THE EXHIBITION

After the opening exercises a private view of the exhibition was given to those present, and this disclosed a great variety of appliances as well as charts, photographs and models of the causes and results of accidents and the means taken to prevent them.

Some models and charts showing the results of poisons encountered in the manufacturing industries were loaned by the German Government. The Travelers' Insurance Company had a collection of boiler plate and tubes which had blown up, wire cables which had broken, and numerous other things which had caused accidents, as well as some safety devices.

Among the many things shown were saw, shaper and planer guards for woodworking machinery, punch-press and emery-wheel guards, respirators, helmets, face masks, and goggles, to protect the lungs and eyes in working in dust of any kind or smoke, elevator gates and clutches, fire extinguishers, lamps and lanterns which would go out and not explode when turned upside down or dropped, miners' lamps and fuse pistols, gasolene cans from which the liquid can be poured into a flame, safety gas jets, railroad signals, brakes, couplers, switches, and non-pull-out spikes, life boats, life preservers, marine signals, first aid to the injured outfits, fireproof building materials, etc.

Business Items

The G. M. Yost Manufacturing Company, manufacturer of vises, has erected and equipped a large plant at Meadville, Crawford county, Pennsylvania.

On May 1 the Curtis & Company Manufacturing Company, St. Louis, will open a branch office in the Hudson Terminal building, New York city. A. E. Hoermann, manager.

The offices of J. J. McCabe, 14 Dey street, New York City, will be moved on May 1 to Hudson Terminal building, Cortlandt and Church streets, New York City. The showrooms and warehouse will be moved to Tenth and Brunswick streets, Jersey City.

The Bristol Company, of Waterbury, Conn., has come under the control of Prof. William H. Bristol, whose inventions this company has been manufacturing since it was first organized in 1889. Professor Bristol assumed active charge of the management of the business on Friday, March 28, and now owns the majority interest. The business which has been carried on under the personal name of Wm. H. Bristol at New York will hereafter be combined with the Bristol Company.

Trade Catalogs

The C. J. Root Company, Bristol, Conn. Catalog of counting machines. Illustrated, 12 pages, 6x8 inches, paper.

The Charles Parker Company, Meriden, Conn. Catalog of vises and ratchet drills. Illustrated. 78 pages, 6x9 inches, paper.

W. H. Leland & Company, Worcester, Mass. Catalog of universal tool and cutter grinder. Illustrated, 14 pages, 6x9 inches, paper.

The Bullard Machine Tool Company, Bridgeport, Conn. Catalog of boring-mill accessories. Illustrated, 68 pages, 6x9 inches, paper.

Beaudry & Company, Inc., 141 Milk street, Boston, Mass. Booklet describing Champion power hammer. Illustrated, 12 pages, 3½x6 inches.

The Heald Machine Company, Worcester, Mass. Catalog describing internal grinding machine. Illustrated, 14 pages, 6x9 inches, paper.

The Oesterlein Machine Company, Cincinnati Ohio. Pamphlet describing No. 2 universal cutter and tool grinder. Illustrated, 16 pages, 6x9 inches.

Western Electric Company, Hawthorne, Ill. Bulletin No. 5910-5 illustrating and describing power equipment for printing offices. 16 pages, 8x10½ inches.

American Emery Wheel Works, Providence, R. I. Catalog describing emery and corundum wheels, diamond tools, emery-wheel dressers, etc. Illustrated, 85 pages, 6x9 inches, paper.

Garvin Machine Company, Spring and Varick streets, New York. Catalog C of standard milling machines, printed in English, German and French. Illustrated, 96 pages, 6x9 inches, paper.

Manufacturers

Eagle Casting and Foundry Company, Winchester, Ky., will erect an addition to its plant.

W. H. Clem, Helena, Ark., will establish lumber and planing mills at a cost of about $15,000.

The Red Wing (Minn.) Sewer Pipe Company will erect a new plant at a cost of about $300,000.

The Continental Motor Company, Muskegon, Mich., will erect an addition to be used as a machine shop.

The Rock Springs & Gibralter Coal Mine, Rock Springs, Wyo.; will want equipment for a machine shop and other machinery.

The Atlanta (Ga.) Hosiery Mills intends, it is said, to rebuild plant recently destroyed at a loss of about $400,000.

The Murray Company, Dallas, Texas, will build a plant at Atlanta, Ga., for manufacturing cotton-ginning machinery.

The plant of the J. J. Newman Lumber Company, Hattiesburg, Miss., was destroyed by fire, causing a loss of $200,000.

The basket and crate factory of Layton & Owens, Bridgeville, Del., was destroyed by fire. Loss $20,000. It will be rebuilt.

Milo A. Morton, Brownwood, Texas, contemplates establishing a plant for the manufacture of automatic washing machines.

The Southwestern Iron Company, Guthrie, Okla., will erect a 80x160-foot addition to its foundry and install a 72-inch cupola.

The Bedford Cotton Mills, Bedford City, Va., is being incorporated with a capital stock of $100,000 by James P. Grey, O. C. Rucker and others. A 5000-spindle plant will be erected.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Back numbers of engineering and technical publications bought and sold. John R. Anderson, 67 Fifth Ave., New York.

Model making. Patented machines manufactured on royalty. Rotary File & Machine Co., 589 Kent Ave., Brooklyn, N. Y.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

If you have a copy of March 7, 1907 AMERICAN MACHINIST we'll give you fifteen cents for it. AMERICAN MACHINIST, 505 Pearl St., New York.

Wanted—Machinist with good ideas to take an interest in fine tool business. Good opportunity to progressive man. E. G. Smith Co., Columbia, Pa.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Wanted—Shaper, about 20" stroke. Vertical power fuel to head. Must be in good conditon and a bargain. Box 29, AMER. MACHINIST.

Gears cut to order, bevel, spur and miter, on Bilgram and Gleason machines. Complete gears furnished. The Cincinnati Gear Works, Murdock Bldg., Cincinnati, Ohio.

Special machinery designed, new ideas developed to practical results; tell me the conditions you wish to improve and I will do the rest. Box 950, AMERICAN MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Machinists take notice. Purchase castings and blue prints of high grade gasoline motor, of world-wide reputation and at a profitable business. Write to-day. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

British patent rules, 1908. We can produce light fine engineering and mechanical specialties and tools, accuracy and finish guaranteed. Model Manufacturing Co., 52 Addison Road North, Holland Park, London.

Business Opportunity for machinery manufacturer or young M. E. with small investment to introduce *the only reversible steam turbine.* Strict and close investigation is offered by experienced and advanced in age M. E. Box 30, AMERICAN MACHINIST.

To Machine Builders—A builder is wanted who is well equipped with up-to-date plant and capital to build on 5 years' contract an Automatic Screw Machine which is very rapid; will cover a large field of work which can not be done by any other Automatic Machine in the market; it is thoroughly advertised the world over; machine can be seen in operation. Box 53 AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Designer with technical education, shop experience and familiar with machine tools, special manufacturing machinery and sheet metal presses and dies wants a responsible positio near Chicago. Box 52, AMERICAN MACHINIST.

MASSACHUSETTS

First-class metal patternmaker, experienced on hand and molding-machine patterns, wishes position. Will go anywhere. Box 938, AMERICAN MACHINIST.

Wanted—Position as foundry foreman on light or heavy work. Can give good reference from present employer. Willing to come on three months trial. Box 51, AMERICAN MACH.

Wanted—Position as designing draftsman by a Swedish technical graduate, 27 years of age, with three years' experience in United States. Box 50, AMERICAN MACHINIST.

Assistant superintendent or tool-room foreman. Technical and practical, thirteen years experienced tool-maker, and designer of modern labor-saving tools, jigs and fixtures for rapidly producing interchangeable parts in large quantities for light, high grade machinery, desires change. A hustler. A-1 references. Box 43, AMERICAN MACHINIST.

NEW JERSEY

Foreman toolmaker, long experience in designing and constructing of dies, jigs and special fixtures of any description, desires change Box 46, AMERICAN MACHINIST.

Wanted—Position by mechanical draftsman on automatic or special machinery, jigs, tools and fixtures. Technical and practical man who is able to design. Box 40, AM. MACHINIST.

A young, up-to-date mechanic, with seventeen years' experience on tools, dies and experimental work; have held position as inspector and had charge. Would accept any position of trust. Box 49, AMERICAN MACHINIST.

A-1 machinist and toolmaker, twelve years executive. Modern, systematic, thorough and competent in directing any class of manufacturing, toolmaking or machine work. Highest references. Box 41, AMERICAN MACNINIST.

NEW YORK

Position wanted as superintendent of a machine shop or a plant engaged in a manufacturing business of any kind. Box 36, AM. MACHINIST.

Position wanted as salesman or demonstrator by first-class toolmaker with drafting experience. At present employed. Box 27, AM. MACHINIST.

Position as superintendent or factory manager by practical mechanic at salary of not less than $4,000. Can buy interest in good prospect. Box 34, AMERICAN MACHINIST.

Draftsman, desires position designing jigs, tools and fixtures. Will go any place in New York, Connecticut, Rhode Island or Massachusetts. Box 44, AMERICAN MACHINIST.

All around mechanic, designer of special machinery and equipment, efficient manager of help, desires responsible position, salary $2,500. Will go anywhere. Box 42, AMER. MACHINIST.

Inventor and engineer; highest standing as developer and designer of machinery; man of business and character; with one concern past 10 years; wants situation. Box 54, AMERICAN MACHINIST.

Mechanical engineer, gas engine expert, college graduate, with extensive experience here and abroad, wants position as superintendent, chief draftsman, representative or salesman. Box 45, AMERICAN MACHINIST.

German mechanical and electrical engineer, age 28. Dresden college graduate, three years' experience in all electrical branches, wants position as mathematical designer or in testing room. Box 37, AMERICAN MACHINIST.

Mechanical engineer, college graduate, wants position as assistant superintendent, chief or designing draftsman; experience in steam engineering, air compressors and pneumatic mining machinery; references A-1. Box 21, AMERICAN MACHINIST.

OHIO

Mechanical engineer and draftsman, experienced in designing special automatic machinery; four years with large builder of water wheels; shop experience; technical education. Box 47, AMERICAN MACHINIST.

PENNSYLVANIA

Draftsman, mechanical and structural, college graduate wants position; salary $20 per week. Address Box 23, AMER. MACHINIST.

Catalogue work, plain and perspective views, any kind of mechanical or general structural work expeditiously and accurately done by experienced draftsman and computer. Box 48, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Draftsman for large jobbing shop doing a great variety of work. Give full particulars and state salary expected. Position is good the year round for the right man and must be filled May 4th. Apply Box 28, AMERICAN MACHINIST.

ILLINOIS

Wanted—A-1 factory manager. Must have a good knowledge of sheet metal business. We require a man with executive ability, one capable of organizing and handling men to the best advantage. Must be practical and up-to-date. Plant is located in Illinois. Give full account of past experience. Correspondence confidential. Box 31, AMERICAN MACHINIST

MARYLAND

Wanted—Experienced draftsmen on general heavy machinery. Address Ellicott Machine Co., Baltimore, Md.

NEW JERSEY

Draftsman on special machinery. Must have shop and drawing room experience. Man with executive ability preferred. State age, experience and give references and salary. Box 35, AMERICAN MACHINIST.

NEW YORK

Toolmakers wanted; a few first class men on jig, fixture and model work; give age, experience in detail, and wages expected. Box 18, AMERICAN MACHINIST.

Wanted—Man familiar with laying out and selling power transmission machinery. State age, experience, reference and salary expected. P. O. Box 2062, New York City.

Foreman for erecting floor wanted. Steam engine works. Small town New York State. State age, experience, references and wages. Box 38, AMERICAN MACHINIST.

Wanted—One draftsman who has had experience in designing power pumps; give references; state salary expected and experience. "X Y Z," AMERICAN MACHINIST.

Machine shop foreman wanted for medium work in a small eastern town. State age, experience, references and lowest wages to start. Address, Box 39, AMERICAN MACHINIST.

Foreman wanted machine department large factory. Requirements are knowledge of drill press, lathe, screw and milling machines, experience in interchangeable manufacturing, ability to handle men, systematize and get out large variety of standard work. Box 26, AMERICAN MACHINIST.

OHIO

We want an experienced wood working machinery designer. Address giving references and experience. Box 20, AMERICAN MACHINIST.

A concern in the middle west building dies, punch presses and drop hammers needs a traveling salesman; applicant should be able to figure on blanking, forming and embossing dies; give references and state salary. Box 17, AMERICAN MACHINIST.

Wanted—By large concern in Middle States four first-class lathe hands, men capable of handling from two to six men and boys and teaching them to do good and rapid lathe work. Applicants will have good opportunity to travel as lathe demonstrators. In writing give past five years' experience. Box 33, AM. MACHINIST.

PENNSYLVANIA

Wanted—First class draftsman on mill construction and equipment, technical man preferred. Box 24, AMERICAN MACHINIST.

VERMONT

Foreman for machine shop building special and automatic machinery; must be first class mechanic and good executive, familiar with modern shop methods, a man who has and can produce results; give full particulars as to experience, age, education, nationality, salary expected and references. Box 25, AM. MACHINIST

For Sale

For Sale—Well equipped general machine shop in New Jersey; employing 15 to 20 hands; good reason for selling. R., Box 1216, New York City.

For Sale—Patents for a door lock with burglar-proof link allowing partial opening of door can be manufactured cheaply; profits large. Apply to Charles Weiser, Receiver, Kalb & Berger Mfg. Co., 49 Exchange Place, New York, N. Y.

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Sames, Chas. M., Jersey City, N. J.

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Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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Gisholt Mach. Co., Madison, Wis.
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Sellers & Co., Inc., Philadelphia, Pa.
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Bardons & Oliver, Cleveland, O.

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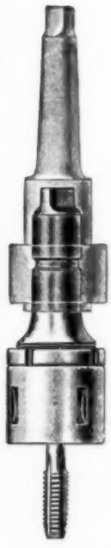

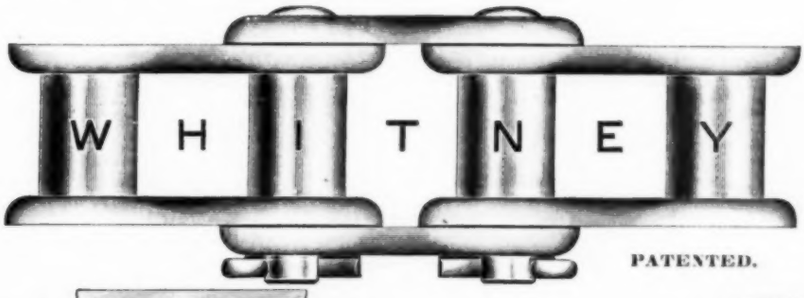

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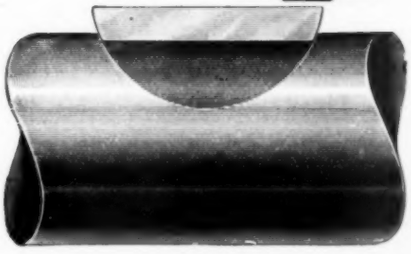

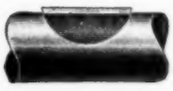

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Skinner Chuck Co., New Britain, Conn.

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Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn
Niles-Bement-Pond Co., New York.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

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Obermayer Co., S., Cincinnati, O.

Compound, Pipe Joint

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Blaisdell Machinery Co., Bradford, Pa.
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Evans Friction Cone Co., Newton Centre, Mass.

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Electric Welding Products Co., Cleveland, Ohio.
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Manville Bros. Co., Waterbury, Conn
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Conn.

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Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery

Veeder Mfg. Co., Hartford, Ct.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
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Evans Friction Cone Co., Newton Centre, Mass.

Countershafts—*Continued.*

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Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Ohio.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

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Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

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Case Mfg. Co., Columbus, O.
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Crescent Forgings Co., Oakmont, Pa.
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Nicholls, Wm. S., New York.
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Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
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Link-Belt Co., Philadelphia, Pa.

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Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Nutter & Barnes Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford Conn.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co Cleveland, O.
Manville Bros Co., Waterbury, Conn
Risdon Tool Works, Waterbury, Conn.
Toledo Machine & Tool Co., Toledo, Ohio

Dies, Sub-Press

Risdon Tool Works, Waterbury, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Allen Co., Chas. G., Barre, Mass.
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

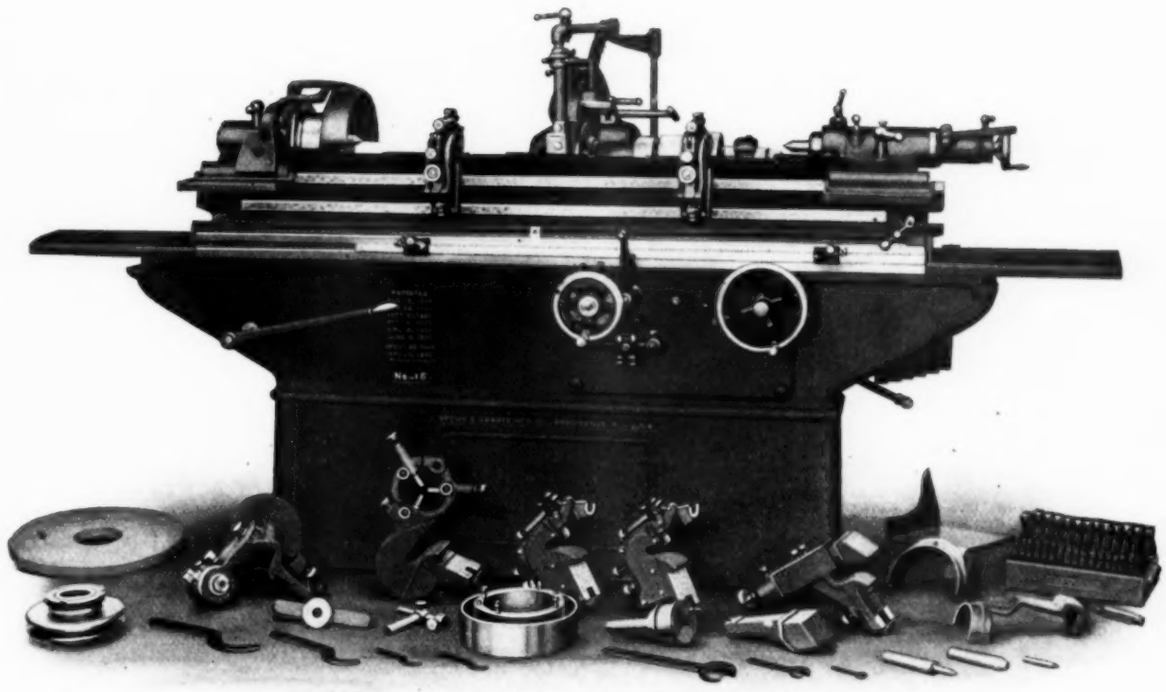
Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.
Technical Supply Co., Scranton, Pa.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.



A Factor that always must be reckoned with in the design of a grinding machine is vibration and the machine that most successfully eliminates this element is the one that lays great emphasis on **RIGIDITY.**

Every Part, then, must be properly designed and Heavy Enough to Carry the Heaviest Job within the Capacity of the Machine. A Heavy Moving Table, a Heavy Wheel Slide and Stand, and Heavy Head and Foot Stock Centres, firmly supported, are essential,—the features of

B. & S. GRINDING MACHINES.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

Allen Co., Chas. G. Barre, Mass.
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

Allen Co., Chas. G., Barre, Mass.
American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Co., Tool Co. Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Rail

Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co. Cleveland O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.

Drills, Ratchet—*Continued.*

Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Sampson, Geo. H.; & Co., Boston, Mass.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill
Sturtevant Co., B. F., Hyde Park Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Works Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill
U. S. Electrical Tool Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadtlphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room

Hart & Cooley Co., New Britain, Conn.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Consulting and Architect

Thompson, Hugh L., Waterbury, Conn.

Engineers, Mechanical and Electrical

Crocker-Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Engines, Steam

Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Export

Churchill & Co., Chas., London, Eng.
C. I. F. Co., New York.

Eyelet Machinery

Manville Bros. Co., Waterbury, Conn.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Nash Co., Geo., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Simonds File Co., Fitchburg, Mass.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Henry & Wright Mfg. Co., Hartford, Conn.

Fittings, Iron

National Tube Co., Pittsburgh, Pa.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Burk Machy. Co., Cleveland, O.
Miner & Peck Mfg. Co., New Haven, Conn.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn
Page Storms Drop Forge Co., Springfield, Mass.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Steel

Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Mc Innes Steel Co., Corry Pa.
Tindel-Morris Co., Eddystone, Pa.